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NOTES & OBSERVATIONS.

ON VARIOUS SUBJECTS

Connected With

ARTILLERY

Laboratory Course

To make Signal Rockets

The cases for signal Rockets are made with a very thick kind of paper called Rocket paper

The paper for the one pound Rocket is cut in halves parallel to the shorter side and the whole of this with one eighth added to it is used for case.

Half of the paper is then rolled once round a brass former then pasted and the wrapping continued till about three inches from the end the other half is then applied and afterwards the eighth; the operation is then continued till the whole be rolled, taking care to keep the

the paper pressed tight to the former the wooden cylinder is then applied to see whether the case is of the proper size, if it is too small, strips of paper are pasted till it will properly fit the cylinder the case is then put into the press and turned briskly round with a screw for about five minutes. Dampers are placed in order to give a proper pressure. The former is then withdrawn and about an inch cut off the end of the case. The wooden former is then introduced at one end the nipple at the other the string of the lathe is then passed round the case about half an inch from the end in order to form the choke and it is worked up and down till the choke fits the nipple tight; seven half latches are tied round the choke to keep it firm. The case is then put into the brass mould with a nipple at the bottom and driven hard in order to complete the formation of the choke. Lastly the case is cut to the proper size and pasted round the mouth and down the side of the case where the paper commences. it is left to dry and when dry

Utensils for making Rocket Cases

1 Brass Former	6 Method of forming the choke
2 Case Gauge	7 Section of the choke
3 1/2 lb Mallet	8 Nipple
4 Wooden Former	12 Cylinder gauge
5 Press	9 Brass Mould
	12 Method of cutting the case
	10 Cutting Stick
	13 Knife

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only it is left for driving. The paper for the half
the Rocket halves parallel to the longer side
1/2 sheet and one eighth is used for it. The
process is the same as for the one the rocket

Attensils for making signal Rockets Cases

1 Pound

A brass former 1 3/4 Inch in diam^r 18 or 20 inches
long a press 1 1/2 Inch in the square a brass mould
1 1/2 Inch in diam^r a wooden cylinder 1 1/2 Inch
in diam^r a wooden former 1 3/4 Inch in diam^r
a knife - and a cutting stick a paste tub &
brush Gauge stick - Rippel - Mettel & Brielle

1/2 Pound

A brass former 1 inch in diameter 2 1/2 Inc^s long
A press 1 1/2 Inch in the square a mould 1 3/4
inch in diameter a wooden former 1 inch
in diameter a wooden cylinder 1 3/4 Inch in diam^r
A knife and a cutting stick one paste tub
and brush Gauge stick - Rippel - Mettel
and Brielle

Composition

Pulverised Salt Peter — 4 lb
Sublimated Sulphur — 1 lb
Dogwood charcoal — 1 1/2 lb

Mixing — The charcoal is first laid upon a tray lined with copper a heavy shot is then rolled over it till it is fine enough to pass through N° 3 sieve, after which the necessary proportion of it is weighed out to be mixed with the other ingredients. The salt peter and sulphur are each separately passed through a fine hair sieve they are then mixed well together by means of a copper plate in a wooden tray and sifted three times through a hair sieve the charcoal is then spread on the tray and the mixture of salt peter and sulphur sifted a fourth time once after which the whole is carefully mixed with a hard brush; the composition is now passed four times through the wire sieve, but should any part remain too large to undergo this process it must be crushed by the shovel until small enough; it is then given to the driver

Driving { first gauge your case to join the interior bottom and its place on the outside with a small brass picker* —

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The case is then placed in the moulder and the moulder screwed fast. The spindle passes through the choke and up the middle of the case, a ladle full of the composition is put into the case and driven down with the longest hollow drift striking 25 blows for the pound and 21 for the half pound rocket with a wooden mallet; weighing 1 pound for the pound rocket and rather less for the half pound. Care must be taken to keep the hollow drift clean with a prick for that purpose; another ladle full is then added and rammed down in the same manner the longer drift in both rockets is used for 9 ladles full after which the second is used for 5 or 6 the third is used till the spindle is quite covered by the composition and the remainder is rammed with the fourth or solid drift making the composition occupy 42 calibres which is known by applying the composition gauge to the drift. This gauge having been previously fixed against the case so as mark the length from the upper end of the case to

the mark of $4\frac{1}{2}$ Calibres, One ladle full of clay will complete the filling. The rocket may then be taken from the mould by unscrewing it and drawing it carefully from the Spindle always turning the case to the right. The half pound rockets are driven nearly the same as the 1st except that there are but two hollow drifts and one solid. You only give 21 blows to one ladle full of composition; a 1st rocket will hold 28 ladders full; and the half pound 25, if properly rammed. —————

N^o B In driving the rockets in order to prevent accidents the body should be kept properly erect; the drift well cleaned after each ladle full, and kept moving turning it backward and forward by a pair of holders for the purpose. —————

* Then apply the diameter gauge putting the bottom of the gauge to the mark which being pressed will mark it at the distance of 1, 2, 3, $3\frac{1}{2}$, $4\frac{1}{2}$ and 5 calibres. $3\frac{1}{2}$ Calibres is driven hollow 1 calibre above that is solid composition, and the remaining half is filled with clay

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To prepare clay for signal rockets

Get the best clay possible and free from gravel or grit; dry it well and pound it; pass it 3 times through a fine hair sieve & dry it; it is then fit for use _____

Utensils for driving 1st signal rockets

One mould and key

4 Drifts 3 hollow and one solid

A box to contain composition

A wooden screen, a block to hold the mould

A wooden mallet and a ladle to contain

5 lbs of composition _____

The utensils for $\frac{1}{2}$ pound rockets are the same except in the drifts and ladle there being

only three drifts 2 hollow and one solid &

the ladle containing 3 lbs of composition

Dimensions of the moulds, Spinnels and
Drifts of 1st signal rockets

The exterior length of the mould is 14 inches

Diameter of the top $3\frac{9}{10}$ inches

Diameter of the bottom $3\frac{9}{10}$ Inches

The exterior length of the mould is 10 Inches in $\frac{5}{10}$

The interior diameter $1\frac{7}{10}$ Inch

The first drift is 12 Inches and $\frac{1}{10}$ long, 1 inch and $\frac{1}{10}$ in diameter, and hollow $6\frac{3}{10}$ inches

The second drift is 10 inches long $1\frac{1}{10}$ inch in diameter and hollow $5\frac{7}{10}$ Inches

The third drift is $7\frac{4}{10}$ Inches long $1\frac{1}{10}$ Inch in diameter and hollow $2\frac{4}{10}$ Inches

The fourth or solid drift is $6\frac{8}{10}$ Inches long $1\frac{1}{10}$ inch in diameter

Dimensions of the spindle

The top is $2\frac{1}{10}$ in diameter, middle $\frac{7}{10}$ and $\frac{1}{2}$ in diam
bottom $\frac{1}{10}$ in diameter length $6\frac{4}{10}$ Inches

Dimensions of Moulds, Spindles and drifts of $1\frac{1}{2}$ lb signal Rockets

The exterior length of the mould $11\frac{1}{10}$ Inches

Diam^r of top $2\frac{4}{10}$ Inches diam^r of bottom 3 in

Interior length of mould $8\frac{3}{10}$ Inches

Interior diameter $1\frac{1}{10}$ Inch

First drift $9\frac{4}{10}$ Inches long $9\frac{1}{10}$ in diam^r
and hollow $5\frac{4}{10}$ Inches

Second drift $7\frac{1}{10}$ long $9\frac{1}{10}$ in diam^r
and hollow $2\frac{1}{10}$ Inches

Third or solid drift 4 Inches long $8\frac{9}{10}$ in diam^r

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Top of spindle $2\frac{1}{10}$ in diameter

Middle $3\frac{1}{10}$

Bottom $4\frac{1}{10}$

Length of spindle 5 inches $2\frac{1}{10}$

Finishing

cut off the case at the top of the clay and bore a hole through the clay to make a communication between the composition and the head of the Rocket. Pull off the paper about $\frac{1}{2}$ an Inch from the head to form a shoulder to fit on a paper cylinder. The length of which for the 1st Rocket is 5 inches and for a $\frac{1}{2}$ lb 3 inches. The cylinders are glued to the Rocket and left to dry. When dry a narrow slip of small arm cartridge paper is pasted round the joint, Mealed powder is then put into the bottom of the cylinder.

3 drs for a 1 lb and 2 drams for a $\frac{1}{2}$ lb Rocket. This serves to burst open the head of the Rocket and light the stars, which are 36 in number in a 1 lb rocket and 22 in a $\frac{1}{2}$ lb rocket. A circular piece of stiff paper is placed over them and this last fastened

Tools for Driving and Finishing Rockets

Mould & Spindle

Setting Stick

Mallet

Comp. Gauge

Slip gauge

Drifts

Wrench

Ladle

Ham. Gauge

1st Rocket finished Wooden Cylinder Bone formers

1/2nd Do

Paper Cylinder

down by pasting over it a thin circular piece of
 paper rather larger than the diameter of the
 cylinder; the cone is then placed over the hole
 by pasting the fringe down the sides of the
 cylinder, the joint is then covered with a
 strip of paper and strips of blue paper are
 pasted over both joints. The Rocket is then
 ready to be tied to the stick, which for a 1^{lb}
 Rocket is 8 feet 2 in. in length and for the 2^{lb}
 6 feet 6 in. The thick end of the stick is placed
 close to the edge of the cylinder and tied
 down with pack thread in two places making
 4 coils round the rocket; a groove is cut in
 the stick to allow it to lay close to the Rocket.
 The whole should balance at $1\frac{1}{2}$ calibres the
 vent of the rocket. The paper cones are formed
 on a wooden form 1.6 inch in diam^t and
 its sides 1.7 in^t in length. The cylinders are
 formed on a wooden former 6 inches in
 length and 1.5 in^t in diam^t for the 1^{lb}
 and 3.4 in^t length and 1.8 inch in diam^t
 for the $\frac{1}{2}$ lb rockets. in the bottom of the

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latter a wooden ring is fastened with a groove
in it, whose interior diameter is 1.3 and its
exterior diameter 1.7

The bottom or cup is primed with meat powder
wetted with spirits of wine and a circle of
small arrow cartridge paper fastened over
the bottom.

The length of the 1 lb Rocket when finished
is between 15 and 16 inches and of the half pound ⁱⁿ 12

The weight of the composition in the 1 lb Rocket
is between 7 or 8 oz. The weight of the 1 lb Rocket
and stick is 1 1/2 lb and of the 1/2 lb Rocket and
stick 13 oz

Utensils for finishing 1 lb and 1/2 lb
Signal Rockets

One table 1 large knife 1 small knife 2 wood
cylinders. 1 rimmer 2 cylinder formers. 1 cone
a paste tub and brush a glue pot & brush and an
engine for putting the stars into a Rocket

Composition for stars

	lb	oz	ans
Saltpeter Pulverised	8	0	0
Sulphur Sublimed	2	0	0
Antimony Powdered	2	0	0
Singlas dissolved	0	3	8

Vinigar 1 quart
Spirits of wine 1 pint

Mixing

The dry ingredients are well mixed together and sifted through a hair sieve. The Singlax is dissolved over a fire with the Vinigar; and the spirits of wine is afterwards added; with this liquid the dry composition is thoroughly mixed. It is then formed into stars of the proper size and shape, with a mould for that purpose which is so constructed as to leave a hole through the middle of the star the stars are then placed in a tray and dried with melted Powder

Utensils for Stars

1. 2. 3 Star Moulds for the 1 Pound Rockets		4. 5. for the 1/2 lb 6 Star Engine

Method of making Potfiers

Cases

The paper for these cases is also made on purpose. The sheet is 2 ft by 18 inches and is cut into a square together. With the part cut off is wrapped tight round an iron formed by means of a hand rolling board the paper is pressed as well as the iron formed, which makes the case to come off easily. The case should be of such a size that it may pass through the proper gauge

Composition {	Salt Petre Pulv ^{ed}	6 lb 3
	Sulphur Subl ^{ed}	6 lb 0
	Byl ^{ar} Meale Powder	1 lb 0

Mixing

The ingredients are well mixed together by drawing them three times with the copper stick. They are then sifted twice through N^o 3 hair sieve and once through a fine hair sieve it is then fit for driving

Driving

The case is placed in a copper mould & screwed fast, a ladle full of the composition is put into the case, and to render this easy as the mouth of the case is

small a wooden cup is placed on the top of the case the longest drift is introduced and 15 blows struck with a 10 lb sledge mallet another ladle full is added and the process continued till the case is full.

Four drifts are used, varying between 6 and 10 inches in length to suit the convenience of the driver.

The bottom of the case is turned without paste. The portfire is primed with meal powder and spirits of wine, it will burn from 10 to 15 minutes.

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Utensils for making & Driving Portfire Case

1 Iron former
2 Hand rolling Board
3 Choker
4 Wrench
5 Mould
6. 7. 8. 9 Drifts

10 Section of the cap
11 Wooden gauge
12 Slice
13 Bridle
14 Block for the mould

The Method of making Fuzes

	Pulverised Saltpeter	3 lb 4 oz
Composition {	Sublimed Sulphur	1 lb 0 oz
	Pit-Meat Powder	2 lb 12 oz

By using Meat Powder is too strong for fuzes

Mixing

The ingredients are mixed together exactly in the same way as those for portfire

Driving

For this operation the fuze is placed in a copper cup which is fixed in a block of elm and the composition driven with iron ~~drift~~ drift tippies at both ends with copper. A ladle full of the composition is put into the fuze the drift is introduced and the proper number of strokes given with a wooden mallet another ladle full is added and the process continued till the fuze is filled to 1/8 of an inch from the cup which is left for the quickmatch. The fuze is then gauged to find the height of the composition and marked on the outside.

Quickmatching

The composition is loosened with a scraper at the top since the quickmatch is carefully doubled and forced down into the fuse by 2 or 3 gentle blows on the drift a little mixed powder having been put into the cup to make the match hold. The fuses for spherical base in addition to this have a few more pieces of Quickmatch laid across one another with their ends passing through holes in the sides of the cup a piece of catgut is passed through one of the holes to which two pieces of doubled Quickmatch are attached. The end is then passed through the next hole and secured outside with a double reef knot.

Priming

The ends of the Quickmatch are laid carefully round the inside of the cup which is primed with a thick paste of meal powder & spirits of wine.

Capping

The next operation is capping the fuse which is done by placing on the top a circular piece of thick cured cartridge paper

and so as to fit the cup exactly a piece of canvas is placed over this and tied Round the side with twine: two coats of paint is laid over on this canvas and a date of the year marked upon it

Length of Lurchmatch for each Nature of fuze			Weights of Mollets for diving fuzes and portfires	
Nature of fuze	Length of match	N ^o of threads		
— 13 Inches	17 Inches	6 threads	— ^{oz} 2	— ^{oz} 1
— 10	14	6	— 1 —	— 10
— 8	12	5	— 1 —	— 4 1/2
— 5 1/2	10	3	— " —	— 14
— 4 3/8	8	3	— " —	— 11
Hand Grinades	3	2	— " —	— 8 1/2
Sp ^t { 8	4	4	— 1 —	— 4 1/2
{ 5 1/2	4	3	— " —	— 14

Drifts for Fuzes

Nature of Sores	First Drift			2nd Drift			3rd Drift			4th Drift			5th Drift			6th Drift			7th Drift			8th Drift			9th Drift			10th Drift			11th Drift			12th Drift			13th Drift			14th Drift			15th Drift			16th Drift			17th Drift			18th Drift			19th Drift			20th Drift			21st Drift			22nd Drift			23rd Drift			24th Drift			25th Drift			26th Drift			27th Drift			28th Drift			29th Drift			30th Drift			31st Drift			32nd Drift			33rd Drift			34th Drift			35th Drift			36th Drift			37th Drift			38th Drift			39th Drift			40th Drift			41st Drift			42nd Drift			43rd Drift			44th Drift			45th Drift			46th Drift			47th Drift			48th Drift			49th Drift			50th Drift			51st Drift			52nd Drift			53rd Drift			54th Drift			55th Drift			56th Drift			57th Drift			58th Drift			59th Drift			60th Drift			61st Drift			62nd Drift			63rd Drift			64th Drift			65th Drift			66th Drift			67th Drift			68th Drift			69th Drift			70th Drift			71st Drift			72nd Drift			73rd Drift			74th Drift			75th Drift			76th 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Method of making Quill Tubes

The quills being first gauged are placed on the rounding board and scraped with the back of the scissars in order to clean them from the exterior pith and to round them.

They are then cut to a proper length viz 24 inch if the Quills allow it the interior pith is likewise driven out: They are then placed in a press and split open which operation is passed over and under the prongs for about 10 or 12 turns a stich is made between every two. The worsted is then cut off under the cup as well as the projecting parts of the prongs.

One boy can prepare between 200 and 300 in a working day of 10 hours

The following implements are used for making these Tubes

An Iron gauge 70 Inches in diameter
A pair of scissars and a board to round the Quills on

A pair of Shears to cut the Quills

A probe to drive out the pith

A splitting knife with 7 prongs

a press to hold Quills in
a needle and worsted

Quill tubes are used for sea service and
are much better and more durable than
tin or brass

Paper Tubes

Small arm cartridge paper is cut into
rectangular pieces $5\frac{1}{2}$ inches by 2

These are made into Tubes on formers of
brass wire N° 9 size by means of the rolling
board. They are passed through a gauge $\frac{7}{10}$
of an inch in diameter, when dry they
are cut to the length of $1\frac{1}{2}$ inch. and then
dry rolled, afterwards they are cupped
with strips of the same kind of paper 17
inches long and $\frac{7}{10}$ broad, the cup should
fit the proper gauge: when dry they are
painted twice

NB one sheet of small arm cartridge paper
will cut into 36 forming strips also one
sheet into 52 cupping strips ———

Composition { Mealea Powder
Spirits of Wine

Method of filling Quill Tubes

place your finger on the cup and dip the other end twice in the composition then pass the drift twice up the Tube and press the composition (not too hard for fear of bursting the Quill) continue the operation till the Tube is filled. You then pierce the Vent through the tube with a thin brass wire and leave it in for a short time. Prime the tube with thin paste of the same composition and clip it into the first to form a body.

Draw the wire out and lastly place a piece of small card cartridge paper over the priming. The match Tubes for sea service have 6 threads of worsted projecting from the cup which are primed with the same composition. Tin Tubes are filled exactly in the same manner as Quill Tubes.

Filling paper Tubes

Paper Tubes are filled in the same manner as the last but the drifts in this instance is pointed in order to give a direction to the

piercing wire. The puttying is a stiff paste
 of mealed powder and spirits of wine
 The caps of the paper tubes are tied on with
 and tin tubes are packed in hundreds
 Paper ones in packages of a quarter of a hundred
 each and metal tubes in half hundreds

Instruments for making Tubes

1 Table with press & knife	6 Quill tube
2 Probe	7 Paper do
3 Spreading knife	8 Tin do
4 Paper tube gauge	9 Paper tube finished
5 Quill do	10 Quill tube finished
	11 Tin finished
	12 Drift for quill & tin tubes
	13 do - Paper

Spherical Case Shot

Spherical Case shot were invented by Col. Shrapnell of the Royal Artillery. Their object is to have the same effect as case shot but at a much greater range -

They are fired either from guns or Howitzers with the same charge of powder. These shells are filled with musket balls and are made much thinner than common shells in order that they may burst with a small charge of powder.

The Fuse Shells are only of two sizes 8 and 5 $\frac{1}{2}$ inch they have a female screw cut in them by a tap and also a shoulder to allow the fuse being driven in firmly.

The fuzes of these shells should be cut so as to make them burst about 50 yds in front of the object.

The shells before use are carefully examined, first by passing them through one gauge and trying them with another through which they must not pass. Secondly they

are placed upon wooden blocks which turn
 on a centre and examined with gauges
 to see if they are of a correct and uniform
 thickness throughout. If there is any
 variation the shell is rejected. After
 this it is further proved by water in the
 following manner. A wooden pipe is
 driven into the fuze hole into this the
 nose of a pair of bellows is inserted
 The shell is then put into a bucket of
 water and the bellows put in action
 If any bubbles rise in the water it is
 rejected but if not the female screw is
 then tapped and the shell then filled
 with musket balls. The fuze is not cut
 to the length allowed for the time of flight
 but is always an inch long and the compo-
 sition is scraped out at the bottom with
 a fuze gauge which can be set so as to
 penetrate the fuze the necessary depth
 for different times of flight. When the time
 of flight is very short the fuze is driven

with mealed powder which burns twice as fast as the composition

Spherical case shot may used with great advantage from 24 & 28 Pth Guns in enfilading works of a fortification and at greater distances than at present practiced viz up to 11 or 12 hundred yds

In this case the shell should just burst over the parapet. On account of the small number of shells contained in the 3 Pth shell as well as the diam^r of the Fuze hole which is the same for all and which causes the Fuze to be frequently blown out without bursting the shell is seldom used with effect for this nature of ordnance

The indiscriminate use of these shells does not run advisably in the field as the difficulty of estimating distances and the great care and attention required in boring and fixing the fuze renders its effect very uncertain in the frequent changes of position which must necessarily take place

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Instruments for proving Shrapnell Shells

1 Instrument for taking
out the fuze
2 Instrument for boring
the fuze
3 Section of the shell

4 Guage for the
thickness at bottom
5 Scale of the guage
6 Caliper for the
thickness at the sides

Quitting Grape Shot

All grape shot consists of 9 balls except those for the 68 P^r which have 13 a canvas bag is put in the tampon and one layer of ball put in, the balls in the second layer are placed in the hollows formed by the first and those of the 3rd layer in the hollows of the second. The process of Quitting is begun by tying the top of the bag with the Quitting line which is carried down to the bottom and taken round the bottom of the shank of the tampon. The Quitting is carried on by making a hitch between every shot. This process must be seen to be well understood. The marline spike is used to make the hitch and is hooked at the end to draw the cord through easier -

The New Method

A new method for grape shot has been invented by M^r Coffin of the laboratory

which been found to succeed and is ordered to be substituted in the service instead of the old. It consists of cast Iron plates with 6 holes round the centre a turn-pike is used as before to keep the plates together the balls are placed in the same way as in Quilting viz in the intervals formed by the preceding layer.

When fired the plates fly to pieces and let the ball at liberty these pieces cause also great damage consequently this new method becomes more formidable than the old which is now entirely to be laid aside.

The Old
Method

The New
Method

Canister Shot

The cases of these shot are made of tin of various sizes according to the nature of ordnance and are filled with balls according to the annexed tables when filled a circular piece of wood of sufficient thickness is put over the balls and the tin case nailed round the top. For sea service the body of the case is formed of tin and the bottom of an iron tampion. The top is of wood as before. Pier shot are counted but the other kinds are thrown in promiscuously

Nature of Fixing Common shot for guns		
1	with 2 oz $\frac{1}{2}$ Shot	10 in a case
2	with 12 oz Do	20 in a case
3	with 1 $\frac{1}{2}$ oz Do	31 Do
4	with 3 oz Do	28 Do
6	with 2 oz Do	40 Do
9	with 3 oz Do	44 Do
12	with 4 oz Do	46 Do
18	with 6 oz Do	46 Do
24	with 8 oz Do	46 Do
32	with 8 oz Do	66 Do
36	with 8 oz Do	75 Do
42	with 8 oz Do	80 Do

Firing Case Shot for Cammucles

$\frac{12}{12}$	with 4 oz — Shot ——— 32 in the case
18	with 6 oz — Do ——— 31 Do
24	with 8 oz — Do ——— 32 Do.
32	with 8 oz — Do ——— 40 Do
42	with 8 oz — Do ——— 66 Do
68	with 8 oz — Do ——— 90 Do

Firing case shot for howitzers

$\frac{12}{4\frac{1}{2}}$	with 2 oz — Shot ——— 55 in the case
$5\frac{1}{2}$	with 3 oz — Do ——— 55 Do
$5\frac{1}{2}$	with 13 oz — Do ——— 20 Do
$5\frac{1}{2}$	with 2 oz — Do ——— 100 Do
64	with 2 oz — Do ——— 175 Do
8	with 6 oz — Do ——— 90 Do
8	with 2 oz — Do ——— 258 Do
10	with 8 oz — Do ——— 190 Do

Firing Pin grape shot ———

$\frac{12}{12}$	with 1 lb — Shot ——— 9 in a case
18	with 1 lb — Do ——— 9 Do
24	with 2 — Do ——— 9 Do
32	with 3 — Do ——— 9 Do
42	with 4 — Do ——— 9 Do

Firing Pin shot for field service

$\frac{12}{12}$	with 2 oz — Do ——— 126 in a case
12	with 6 lb — Do ——— 41 Do
9	with 1 lb — Do ——— 126 Do
9	with 5 — Do ——— 41 Do
6	with 3 lb — Do ——— 41 Do
6	with 1 lb — Do ——— 85 Do
3	with 1 lb — Do ——— 41 Do

Small arm ammunition

For musket the long side of a double sheet of small arm cartridge paper is divided into 3 equal parts and the paper is folded at the points division parallel to the shorter side. The opposite angles of the parallelogram thus formed are then brought together and folded making 12 forming pieces.

For carbines a sheet of the same paper is folded into 4 parts then doubled and the opposite angles brought together as before forming 16 pieces. For the common pistol the sheet is doubled parallel to the longer side and ^{triple} parallel to the shorter it is again doubled and the opposite corners brought together as before thus forming 24 pieces. A former of the same diameter as the ball hollowed at one end to admit

part of the ball is placed on the paper the paper is then wound tight round the former and ball it is then choked at the end of the ball $\frac{1}{2}$ an Inch being left for that purpose the choke is fastened by two half hitches and a thumb hitch the cartridge is also tied above the ball in the same manner the former is then withdrawn and the proper quantity of powder put in, the cartridge is then tied above the powder and is finished

Packing Cartridge

10 Musket Cartridges are made into 1 packet and $\frac{1}{2}$ of a sheet of paper in a long slip is used for this purpose 1 cartridge is placed at one end wrapped round once another is then placed under and the paper brought over a third is placed

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is placed over, a fourth under, and a fifth over.
5 more are placed over these observing observing
the same process taking care that all the
cartridges lie with the ball and powder
alternately. The whole is then wrapped up
in 2 quarter of a sheet of paper and tied.

A half of paper will form 8 packing slips
for carbine cartridges and a sheet will form
1/2 musket packing slip and 8 packing slips
for a pistol.

38 Method of making Ball Cartridge

Casting Bullets

The bullets are cast in moulds which throw off 6 at a time one man casts 4 or 500 in an hour, or cut 120 bars in a minute

No 2 Bare Packages for small arm ammunition							
Nature		Box	Half Barrel	2 ^d Barrel	1 st Shot	In a Line	In a Row
Hall Price		636	600	300	8	192	3840
Ball Cartridge	Musquet	900	1000	500	12	288	576
	Carbine Mus ^t Bore	1000	1000	500	12	288	5760
	Pistol do do	100	1400	700	12	288	5760
	Carbine	1040	1500	750	16	384	7680
	New Pattern Carbine or Pistol Carbine bore	1040	1500	750	16	384	7680
	Pistol	1360	2000	1000	24	576	11520
	Long Price 30 to the	1100	"	1000	24	576	11520
	Rifle 22 to the	1220	1500	750	16	384	7680
7 Barrel Gun		a small kg	1000	36	864	17280	
Blank Cartridge	Musquet	"	1500	750	16	384	7680
	Carbine	"	1800	900	16	384	7680
	Carb ^e Mus ^t bore	"	1600	800	16	384	7680
	Pistol Mus ^t Bore	"	200	1000	16	384	7680
	Pistol Carb ^e bore	"	2000	1050	16	384	780
	Common Pistol	"	2500	1300	24	576	11520

Table for small arm ammunition
Not sold

Weight of shot used for Small arms					Weight of Powder in each cartridge			
Weapons	Service		Proof		Service	Proof	Exercise	
Wall Piece	7	76½	6	672	10	2" 8	"	"
Musquet	14½	1624	11	1232	6	1" 7½	5	"
Carbine	20	2240	17	1904	4	0" 15	4	"
Com ^d Pistol	34	3808	28	3136	3	0" 9	3	"
Pistol Carbine one or new Patent Carbine	20	2240	17	1904	3	"	"	"
7 Barrel Gun	46½	5208	"	"	1½	"	"	"
Buck Shot	105	11760	"	"	"	"	"	"
Rifle arms	22	2464	"	"	4	"	"	"
Fowling piece	30	3360	"	"	3	"	"	"
French Musquet	17	1904	"	"	5½	"	"	"
French Carbine	20	2240	"	"	5½	"	"	"
Carbine Musquet Box	14½	1624	"	"	4	"	4½	"
Pistol Musquet box	14½	1624	"	"	3½	"	3	"

Method of ~~packing~~ and tying cartridge bags

When the proper quantity of powder is put into the cartridge bags, take a needle with 3 threads of worsted and draw the mouth of the bag close up to the powder with a running stitch, and wrap it round 3 times to keep it firm in its position this is stitched 3 or four times over and under according to the cartridge make 1, 2 or 3 loops round it to keep it in shape each loop is stitched to keep it in its position. The cartridge is then put into a paper bag to preserve it till required for use.

For the 3rd Mountain Service gun the ball is attached to the cartridge thus the ball is first capped with a flat, ^{bottomed} piece of wood having two grooves cut round it and fastened by means of tin slips: it is then introduced into the cartridge close to the powder & tied with worsted round one of the grooves.

A cylinder of paper is then put over the cartridge and wood and tied twice when the grooves are afterwards the flannel is cut away from the ball the whole is then put into a paper bag the paper being kept downwards till required for use. Canister Shot for 3 Pz are attached in the same manner

The Method of Pulverising Saltpetre

The Peter is received from the cartridge in cakes and in order to pulverise it 16 pounds of the Peter and 4 Quarts of water are put into a copper Cauldron over a charcoal fire. as the water evaporates 2 men work it round with

wooden paddles tipped with copper during the latter part of the process occasionally taking it off the fire till the evaporation ceases. it is still to be kept well stirred putting it on the fire now and then till it is brought to a fine powder quite dry it is then taken out and sifted through a hair sieve and lastly it spread over paper to cool

Method of Mealing Powder

A small quantity of powder is placed on the table which is made of beech wood and is 6 feet by 4 so that two men may work at the same time on opposite sides of the table. The powder is then mealled with a rubber till small enough till pass through a hair sieve which is covered at top and bottom to prevent the loose particles of powder from flying away. If any of the powder remains in the sieve it must be placed on the table and rubbed again. The rubber is made of beech

wood and both it and the table are scored. There are two kinds of mealed Powder Cylinder and pit-mealed powder which take their names from the particular ways in which the charcoal is burned the charcoal for one being burnt in a cylinder and for the other in a pit.

Method of making and filling a Petard

After the Petard with its bed is taken out of the box the two props are to be well secured in the eye bolts with the spring keys also the Petard is to be well filled with the proper quantity of powder powdered in through a copper funnel. Grease the screws put in the fuze and set quite home in the vent with the wrench, thus the Petard being loaded must be conveyed to the gate or door intended to be broken open fixing it so as to allow a proper bearing for the forks of the props with the gimlet bore the holes for the hooks to hang the Petard on the hooks being first greased are to be well screwed into the gate with the wrench.

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ever the petard is to be hung on the hooks
by its rings.

Return of articles packed for a Petard
a Petard

Two hooks to hang the Petard on
Two gimlets

One copper Fuse

One Wrench

Six blew paper portiers

Four yards of common slow match
a match case

Two props

One copper Funnel

One Cartridge with 1 lb of powder
Eight ounces of tallow

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Method of making Blue Lights

The composition for blue lights consists of

Grouse Saltpeter	1	12	0
Sublimed Saltpeter	0	7	0
Red Oxymment	0	2	0

These are mixed together on a beech wood table by drawing them three times with the slide and sifting them twice through No 3 sieve

Filling the Cups

The cups are filled by pressing them down on the composition the superfluous part being scraped away by a wooden spatula. A cap of small ann cartridge paper with two or three pieces of quick match placed across one another and their ends passing through so as to touch, the composition is placed over the cup another piece of the paper is placed over this and tied down with two half hitches and a thumb hitch

The ends are then cut off and the whole is covered with a piece of common cartridge paper which is pasted down the side to prevent the paste getting on the top of the cup the capping paper is placed on a board and the mouth of the cup placed in the centre then the paste is applied all round: A thin slip of common cartridge paper is pasted round the outside of the cup to keep the capping paper down they are then laid to dry and when dry are ready for use. The common Cartridge paper is damped before used

Quick Match

Quick match is made of cotton from 2 to 6 threads in thickness. The 2 threads are used for lance grenades

3	4 $\frac{1}{2}$ and 5 $\frac{1}{2}$ inch
4	8 inch Spherical
5	8 inch common
6	10 and 13

To 7 oz of cotton enclosed

6 oz of Salt Peter

$\frac{1}{4}$ Pint of water

1 Do Spoon of wine

$\frac{2}{4}$ lb of meal'd Powder

The Saltpeter is first put into the Pan and the cotton drawn over it (each end of the cotton should be tied to the handles of the pan) the water is poured over the cotton which is pressed down with the handle that it may seal up ^a the water. The pan is then placed over the fire not too quick and allowed to boil till the water is nearly evaporated. During the evaporation the cotton is daubed about with a piece of wood. The spirits of wine is then added and the boiling continued till nearly dry. The pan is then taken off the fire and cooled by dipping the bottom in cold water. Meal'd Powder is then strewn over about $\frac{1}{3}$ of the quantity and put by to soak for 6

for 6 hours it is then drawn through the hand into another pan and 1/2 more of the powder added it is again allowed to stand 6 hours it is afterwards run off to dry and the remainder of the powder sifted over it through a hair sieve. In summer quickmatch takes 10 days to be thoroughly dried it is cut into proper lengths and packed up with the number of threads and marked outside of the paper

Hand Lights

The Composition for these consists of

	lb	oz	dr
Saltpetre Pelletised	6	0	0

Saltpetre Sublimed	3	0	0
--------------------	---	---	---

Cyl ^{ar} powder	1	4	0
--------------------------	---	---	---

These ingredients are well mixed together and about 6 drams of the composition put into the case at a time and 10 blows struck with a small mallet the operation is continued till the case is nearly filled

a Wooden Drift is used for the Draining of the composition of the same diameter as the bore of the case a circular piece of paper with a cross match is put over the composition and this again covered with a piece of small card cartridge paper tow is wrapped round the case and covered with lute which consists of

Rosin	lb	oz	Dr
Beeswax	7	8	0
Pitch	6	14	0
Sallow	1	14	0

all melted together after which the lute is put over the tow. and whilst wet sawdust is strewed over the case to prevent them sticking to the hand then lights are used for getting fire to Batteries and wooden Buildings

Caucases

Caucases consist of shells having 3 holes in them when filling 2 of these holes are plugged up

Composition

Salt-petre Pulv ^{er}	lb	oz	Dr
Rosin	6	4	0
	1	14	0

Sulphur Sublimed.....	lb. oz. dr.
	2..8..0
Antimony powdered.....	0..10..8
Tallow.....	0..10..0
Serpentine.....	0..10..0

The dry ingredients are first mixed together with a rubber on a beech wood table.

The tallow and serpentine are mixed together in an iron pot which is placed in a copper one containing about 27 gallons of olive oil, this to prevent the fire from getting in to the composition and it is found when in constant use one supply of oil will last 6 months before it need to be replenished the evaporation being very slow likewise the heat it gives is quite sufficient to melt and incorporate the compositions of this nature. When the tallow and serpentine are well mixed the composition is added and the whole is well beaten together for ten minutes.

or a $\frac{1}{2}$ of an hour with a paddle it is then taken out and laid outside, when sufficiently cool the filling commences in the following manner

A funnel is placed over the open hole and the composition put in by small bits rolled with the hand and rammed with the wooden drift till the carcass is quite full. The plugs are then removed from the other holes and drifts substituted which penetrate the composition about 2 inches and plug up the holes at the same time, when the three holes are thus stopped the plugs are tied down so the expansion of the composition would drive them out. When the carcass is dry and hard the drifts are removed and holes driven with fuzee composition. Carcasses are thrown from mortars and their object is to set fire to arsenals &c —

Carcass, the Plug tied Down

Light Balls

The cases for light balls consist of an iron hollow bottom having 4 ribs of the same metal which are kept together near the top with an iron ring the ribs are covered with carcass a hole is made in this between 2 ribs and near the top to put the composition in which consists of

Salt petre Pulve ^d -----	6..4..0
Salt Petre ground -----	2..8..0
Rosin powdered .. --	1..14..0
Linseed oil -----	6..7..8

The oil is first put into the iron pot till it boiles the dry ingredients which are previously mixed together on the table

are then added and the whole turned about with the paddle till of the requisite consistency it is then taken out to cool and when sufficiently so to handle the filling commences ^{in a} ~~in a~~ ^{reformation} in a similar way to Carcasses

When filled a whole like the first is made in the cavity between every two ribs; shifts are put in and left there till the composition is dry and hard; the holes are then filled with ^{ed} fuse composition and primed and quickmatch

Light balls are principally used by the Garrison of a besieged Fortress to observe the offensive operations of the enemy during the night

Sketch of case for
Light balls

Light ball

Valuticennis Stars

	Pulverised Saltpeter	6	4
Composition	Sublimed Saltpeter	2..	8
	Powdered Nitro	1..	4
	Powdered Antimony	..	10
	Essenced Oil		6. 11d

These are mixed in the same manner as the ingredients for carcasses

To make the stars the proper weight of composition is put into a mould having a spindle up its centre and rounded by a hollow drift. The mould is capable of holding 3 stars and between each a copper plate is to be fixed

The interior diameter of the mould is to be the diameter of the pore hole of the drift for which the stars are intended

When made the stars are covered with paper and the hole left by the spindle filled with fuse composition and primed at one end with spirits of wine and sealed however

To use them a certain number is put into common shells with the bursting powder which are then called live shells and serve instead of carcasses; the number of stars for the different shells are 4 for the 13. 10. and 8 inch and 6 for a smaller size

for the 3½ and 4½ Inch. They were first used as Valencienne by the Austrians and is the only composition known that when lighted can not be extinguished

Smoke balls

To make cases for smoke balls spherical moulds made of wood are employed varying in size according to the nature of the mortar from which the ball is to be fired

The mould is first well greased and a nail is driven into it to which a string is afterwards attached to have it hung up by

A piece of common cartridge paper made very wet and tightly pasted is then wrapped the mould and cut so as to be quite even circular pieces of paper are then laid on the ends which are likewise made perfectly

perfectly even. Another coat is then laid on the reverse way and so on each succeeding coat being laid on opposite directions till about 4 or 6 layers have been placed on the mould.

It is then hung up and when dry the mould is taken out by cutting the case nearly in halves. The opening is then closed by pasting strips of paper across it.

The operation is carried on in this way till the case comes up to a certain gauge. The fuse hole is then burnt and it is ready for filling.

Composition	{	Corned powder bruised	3.	0
		Pulverised Sattfelter	1	" "
		Sea coal	1	" 8
		Swedish Pitch	2	" "
		Tallow	"	8

A small quantity of dry composition is put in to the balls at 3 different times viz when they are a quarter full $\frac{1}{4}$ of composition is put in another third is put in when half full and the rest when $\frac{3}{4}$ full.

The quantity for the different sorts of shells
are as follow —————

		oz	lbs
for 12 Inch —	{ Sulphur —————	2	6
	{ Sea coal —————	2	0
10 Inch —	{ Sulphur —————	1	"
	{ Sea coal —————	1	"
8 Inch —	{ Sulphur —————	"	8
	{ Sea coal —————	"	8

The cases are filled in the same way as Carcasses
and when full a plug is put in and tied
down till the composition is dry

The hole made by the fuze is then
filled with fuze composition pruned and
quicksmatch

Smoke balls are used to cover
the retreat of an army opposed they are
also thrown into the enemies mines to prevent
the miners from continuing their work

Smoke ball before
priming

Plugs for base

Fire Barrels

Composition	{	Pulverised Sulphur	6 .. 4
		Ground Sulphur	2 .. 8
		Pounded Rosin	1 - 14
		Pounded Antimony	10
		Tallow	10

This Composition is put into the barrel and used for the ships

Reeds and Beams are also used on board of fire ships they are covered in the following Composition

Composition	{	Pulverised Sulphur	40
		Sublimated Sulphur	20
		Pitch	24
		Rosin	28
		Guispentine	12

Gunpowder

Gunpowder is formed by an intimate mixture of Saltpeter charcoal and sulphur its quality depends on the proportions these ingredients bear to each other on their purity on the degree of fineness to which they are reduced and on the care with they are mixed

The proportion which the Saltpeter bears to the other two ingredients is now fixed to be as 3 to 1 the quantity of sulphur should be as 3 to 2

The proportions of Sulphur may be reduced or even dispensed with entirely but on that case the powder becomes porous has very little consistency incurs damages in travelling and the composition requires much greater care in mixing when the proportion of Sulphur is reduced below ^{to} 3 to 100 the powder has all the above defects

By measuring the proportion of charcoal the same inconveniences arise as by diminishing the sulphur exceed to which the powder contracts more moisture from the atmosphere

The saltpeter should be very pure & perfectly dry for the salt which it contains in its impure state deliquescent or anhydrous - tible they will cause the powder to moulder

moisture or diminish its strength. The choice of charcoal is also very essential Poplar Logwood willow or Hazel are considered best it should be dry light and easy to pulverize should present a clean fracture when broken and have been recently made as imbibes moisture very rapidly when exposed to the air

The great improvement in the strength of powder is principally owing to the process of Charring the wood in Iron Cylinders hence to term Cylinder powder

The wood is put into cast Iron Cylinders placed horizontally over stoves and the front openings closed: heat being applied the Pyroligneous and a large portion of Carbonated Hydrogen gas come away through tubes inserted in the back part of the vessels. The Gas is sufficient to escape and the liquor is collected in vessels and the charcoal is left pure in the Iron Retorts

The sulphur should be purified by Sublimation in mixing the ingredients in a mortar about 2 lb of water to 20 lb of composition is added

Analysis of Gunpowder

75 parts of nitrate of potash	24.75	Oxygen	19.796
	Nitric Acid	Nitrogen	4.954
	36.75	Oxygen	6.108
	Potash	Potassium	30.442
	13.50		11.439
			2.023
Charcoal			15.000
Sulphur			10.000

This the Saltpetre which is the most essential ingredient furnishes oxygen azote and Caloric

The charcoal produces much gas the Sulphur renders the combustion rapid and facilitates the inflammation of the powder

The Components of nitric Acid have a very slight affinity for each other but oxygen which is one of them has a great tendency to combine with Carbon. Therefore as soon as a spark falls on the powder the Carbon with rapidity and the oxygen which disengages itself from the nitrate of potash combines with the Carbon and forms Carbon Acid gas

The Oxygen at the same time separates from the azote another element of the nitric Acid the carbonic Acid in order to be in a state of gas only requires half the caloric which the oxygen absorbs and which was before combined with the

with the Saltpetre this Superabundant Caloric
produces an expansion of the carbonic Acid azote
and Hydrogen gases contained in the powder
and of the Atmospheric Air and also reduces
into vapour the water which the Charcoal
may have contained. Lastly these gases
expanded by the superabundant caloric
dart forward with unconceivable velocity and
produce the astonishing effects of Gunpowder.

Proof of Powder as carried on at
His Majesty's magazines at Woolwich.

The Powder in the British Service is partly
manufactured at the Kings Mills; But the
Greater part is supplied by Merchants
under contracts.

The Powder undergoes a severe test
at the place of Manufacture; and can always
be relied on but as this is not the case with
the latter it is necessary to compare it
with that which is good to ascertain whether
it possesses sufficient strength and whether
its ingredients are sufficiently pure to
admit of its being received into the service.

To determine this the following methods
are adopted 1st what is technically called
the survey 2nd firing it from a mortar
a carbine according to the nature of the

of the Powder in comparison with the Kings 3rd Inflaming it on a copper plate 4th weighing it in comparison with the Kings

These proofs are carried on in the following manner First - the Merchants deliver their powder in lots of 100 barrels each 89 of which are large grained and the remaining 11 fine

The Rasks are unheaved and set out in a place appropriate for the purpose it then undergoes the survey that is a small quantity from each barrel is cut here in the barrel once if it is soft grained so as to set in lumps it is considered unfit for service and rejected should it pass this proof it undergoes a second a small quantity of the large grained powder is taken from each of the barrels and mixed together 3 Rounds are then fired out of 3.8 Inch mortars with 68 lb shot under a charge of 203: The average Range is taken from each mortar and compared with the Ranges produced by 1 Round of Kings powder from the same mortars which as well as the shot are made perfectly clean before priming each shot being fired from its own mortar

If the Merchants powder gives a range within 100 of the of the Kings and five feet over it is allowed to pass this proof

The small grained powder is taken in the same manner and a Steel ball is fired from a carbine with the service charge placed at 12 yards from a frame in which 18 half inch elm boards are set $\frac{1}{4}$ of an inch apart

They are previously soaked in water to prevent their splitting and to prevent the greater resistance. Two rounds being fired with Mechanics powder and two with the Rings the former is allowed to pierce one board left than the latter but should it fall short of this it is rejected. In loading the Carbine the Charge is conveyed to the bottom by means of a copper funnel with a long pipe which delivers the charge at the bottom in order that no powder may be lost by adhesion to the barrel.

Thirdly a small quantity of powder is inflamed on a copper plate if it ignites easily without making sparks which are termed lights and leave no impurities or beads on the plate it passes this proof.

Fourthly the powder is sometimes put uncovered into a perforated chest which is placed in a Magazine and the powder left to the action of the Atmosphere for 14 days: it is then taken out and weighed with comparison with the Rings powder which has been exposed in the same chest and if it gains in weight it is a proof that

that the powder has imbibed more Atmosphere
Moisture than the Kings and consequently
not being so well Manufactured it is rejected

In this exposure 100 lb should not
absorb more than 12 oz or something less than
1 per cwt

The last proof is that of cubing
or weighing a certain measure of Merchants
powder against the same measure of the Kings
Should it prove light it is proof that it
has not been sufficiently worked

This proof is seldom resorted to but
it acts as a check against the Manufac-
ture 102 lb of powder are demanded of the
Ships Gunner for every 100 lb issued after
a six months voyage

Powder that has been issued and
returned is if injured by the atmosphere
mixed with the best powder and proved if
dusty it is sent to the Mills to be cleaned

Powder Marks

R A For Rifle Arms

R S In Tellow is restored

The Red L & G denote powder made entirely of Cylinder Charcoal which is always used on service

The White L & G being a mixed Powder is not so uniform as the other and is therefore used for filling shells or for such purposes as do not require a great accuracy. All Powder for service is mixed in proportions according to its strength so as to render its force as uniform as possible

Plan of a 9 P^r

Section of a 9 Pounder

Names of the different Parts of a GUN.

AB	Length	RG	Brush
AC	First Reinforce	S	Button
DE	Chase	a b	Button Ring
ER	Muzzle	c d	Neck
FA	Cascable	e f	Neck Fillet
GH	Bore	g g	Breech Ogee
RH	Axis	h h	Base Ring
G	Bottom of the Bore	i i	Base Ring Ogee
II	Trunnions	k k	Vent Field Astragal and Fillet
KK	Dolphins	o d	Muzzle Mouldings
LL	Vent Field	ll	First Reinforce Ring
M	Pen	mm	Second do and Ogee
N	Vent	nn	Muzzle Astragal and Fillets
O	Swell of the Muzzle	ss	Shoulders of Trunnions
CD	Second Reinforce	tu	Calibre

General Construction

18. 12, 9, 6 and 3 Pounds of 17 Calibres. $\frac{3}{4}$. $\frac{3}{8}$. AB $\frac{3}{8}$ of AF
 24. 18, & 12 Pounds of 13 Calibres. $\frac{6}{8}$. $\frac{3}{8}$. AC $\frac{3}{8}$ of AF
 6 Pounds (light) of 5 feet and 6 cwt. $\frac{1}{16}$. $\frac{3}{8}$. CD 1 Calibre.
 3 Pounds of 6 Feet. $\frac{1}{3}$. $\frac{3}{8}$. EF $\frac{1}{3}$ of DF
 1 Pounder of 5 Feet. $\frac{1}{8}$. $\frac{3}{8}$. EO $\frac{1}{3}$ of EF
 CD in these Guns $\frac{3}{4}$ of a Calibre.

of BRASS GUNS.

		Guns			
		mm	op	q	17
Trunnions	The dispart 1 Degree	17	Calibers	1/2 Cal	4 1/16 - 4 3/16 - 6 1/16
	Diameter 1/3 GH	13	do	do	do do do do
	Pommel	6	P' 6 feet	Cal	3/4 - 1/2 - 1/2
	Length Diameter	1	P' 5 Feet	do	3/4 - 1/2 - 1/2
		3	P' 5 Feet and 6 cwt	9/16 - 5/8 - 3/4 - 6 1/16

General Construction

- AF Length of the Piece*
AB First Reinforce $\frac{2}{7}$ of *AF*
AC Distance of the Centre of the Trunnions
from the base Ring $\frac{3}{7}$ of *AF*
BD Second Reinforce $\frac{1}{7}$ of *A* + 1 Calibre *CD* 1 Calibre
DE Chase $\frac{4}{5}$ of *DF*
EF Muzzle $\frac{1}{4}$ of *DF*. *NF muzzle Moulding* $\frac{1}{4}$ of *EF*
AL $\frac{1}{6}$ of *AB*
Rings and Astrigals including fillets $\frac{1}{3}$ of *AL*
Fillets $\frac{1}{4}$ of their rings
Ogee at D $\frac{1}{4}$ of its ring
 Trunnions $\left\{ \begin{array}{l} \text{TV 1 Caliber} \\ \text{Diameter 2, v} \end{array} \right.$

of IRON GUNS.

GH Thickness of Metal	42 Pounder..... 1 Caliber	
	32.....	$1\frac{1}{6}$
	24.....	$1\frac{2}{6}$
	18.....	$1\frac{3}{6}$
	12.....	$1\frac{4}{6}$
	9.....	$1\frac{5}{6}$
	6.....	$1\frac{4}{6}$

I.R. $\frac{1}{2}$ C.H.

24 P^r Brass Howitzer

12 P^r Brass Howitzer

10 Inch Iron Howitzer
Length 6 Calibres

Weight 40 Cwt
To contain 7 lbs of Powder

8 Inch IRON Howitzer

Length 6 Calibres
Weight 20 Cwt
To contain 4 lbs of Powder

General Construction of CARRONADES.

To determine vt. uw , an arc must
 be described from $z = WX$.
 Chamber to contain $\frac{1}{2}$ wt of Shot
 Diameter of Chamber = bore of next
 less nature of Ordnance
 Breadth of coin Patch 1 Caliber

$ab =$	2	Caliber $\frac{11 \frac{2}{3}}{16}$
$bc =$	4	$\frac{1 \frac{1}{2}}{16}$
$ac =$	7	
$de =$	2	
$ez =$	$\frac{7}{10}$	
$gh =$	$2 \frac{10}{16}$	
$ik =$	$2 \frac{6 \frac{1}{2}}{16}$	

General Construction for 13. 10. & 8 Inch Iron

Land Service Mortars

A.B	$\frac{3}{4}$	Calibre
B.C	$\frac{1}{6}$	do
C.D		do
D.E		do
E.F		do
F.G		do

8 Inch has no Dolphins

General Construction of

13 and 10 Inch IRON Sec Service MORTARS

For 13 Inch
 $A.B = 1\frac{1}{16}$
 $A.C = 2\frac{1}{16}$
 $A.D = 3\frac{1}{16}$
 $A.E = 4\frac{1}{16}$

Length of Trunnions
 13 Inch 8.531 Inch

For 10 Inch
 $A.B = 1\frac{1}{16}$
 $A.C = 2\frac{1}{16}$
 $A.D = 3\frac{3}{16}$
 $A.E = 4\frac{9}{16}$

68 Pounder Gun

Length 10 Calibers

Weight 50 cwt

Diameter 8.05 Inches

SIR W Congreves 24 Pounder Cartridges

Gun

Length 7 1/4 feet
Weight 41 cwt

A a 6.05
A B 34.65
A D 38.0
A E 81.5
A C 9.0
A

Length of the Bore 83.95
Diameter 5.825
Diameter of the Cup }
Muzzle } — 6.75

FOUNDERY.

On Casting Brass Ordnance

The First Step in casting Brass Ordnance is a formation of the Mould of the Gun it is intended to make and the operation is commenced in the following manner a wooden spindle having the shape of a frustum of a cone is laid horizontally on two edges of a trough about 2 feet high, at the larger end of the spindle cross sticks or handspikes are fixed for the purpose of turning it round

Bands of plaster straw or hemp are then twisted round the spindle so as to form as near as possible the size and figure of the intended Gun

This being done the whole is covered with 3 coats a mixture sand Horse dung and loam each succeeding coat being finer than the preceding one; the external configuration of the mould by means of a board called the modelling board which

is laid on the edge of the trough having the different mouldings & cut in it then by turning the model round so as to meet this board the proper slope is given to it.

The model thus formed is then dried and hardened by means of a Charcoal fire which is placed underneath it in the trough after which it is washed over with a solution of Gin ashes to prevent its adhering to the mould. The turnions are made of wood and fastened to the model by means of iron pins the Vent field is also a separate thing it is formed of lead and nailed to the model.

Models

The next thing to be done is the moulder which is made in 3 different parts viz the Casable the length of the Gun and the dead head which last consists of a cylinder extending about 2 feet beyond the muzzle for the purpose of giving a greater degree of solidity to the Gun: It may however be observed that in short Guns the length of the piece and the dead heads may be joined together to make the mould a mixture of sand, loam and cowhair is laid on the model and on it a thin layer of tow it is then thoroughly dried by a Charcoal fire when another coat is added and so on till it has attained the thickness of about 2 inches the mass is kept firm & compact by bars of iron bound round with hoops and a coat of clay is afterwards put over the whole thus filling up the intervals between the bars

Moulders

The mould is disengaged from the model by knocking the Spindle out and this being away with it the plastered straw and a portion of the model the remainder is easily crumbled and thus got out by means of burning wood placed in its interior. The wooden trunnions are also knocked in and fall out with the rest of the model. This being done the Mould is placed on an iron plate and thoroughly dried by burning hop poles in it which operation being done is called Baking the mould. The mould of the dead head which has been extracted in a similar way from the Model is now secured on two hooks at the ends of the bars of the other part.

It now remains to form the Cascade the model of which is marked on an iron spindle and in other respects precisely in the same way as that of the Gun the mould is made on it and when finished and disengaged from it is placed in an iron case it has a rim made all round it that it may fit better to the mould of the Gun the iron case is made

red hot by a charcoal fire to prevent any possibility of clump in the mould

section of the Mould

A . Section of the Mould

B . Cascable

C . Mould Complete

D . Dead Head

All the moulds being now finished the casca-
bles are placed upright in a pit close to
the furnace in which the metal is to be melted
the moulds of the Guns are then placed on
them having their tops covered and the pit
well filled with well dried clay previous-
however to its being completely filled
iron plates covered with Mould composi-
tion are placed at the bottom of the
turnions after which the clay is closely
rammed and carried to the requisite height

The Metal is conveyed from the
furnace in a trough made of fire bricks
cemented with loam to the opposite side
of it and in removing the plug from the
furnace the metal issues out and runs
into the openings made in the elevated
heads; after the moulds are filled should
any of the metal remain it is conveyed to
a reservoir made for that purpose on
one side of the pit Gun Metal is composed
of a mixture of copper and tin and the
proportion consists in about 10 or 12 parts
of tin in 100 of the composition; Copper is
very malleable and possesses great tenacity

and tin possessing fusibility without being so malleable or tenacious as copper. The mixture is better for Guns than either would be alone. The former melts at about 1200 Fahrenheit whilst the latter only requires a heat of 442° to reduce to a liquid state.

It is usual to make the Vents of copper alone on account of its non fusibility those parts of course being more exposed to the action of fire than any others.

After remaining two or three days to cool the Guns are taken out of the pit and separated from the moulds. The Guns are now taken to a Room where the dead heads are turned off and they are filed and chiselled. They are next removed to another shop where they are turned and bored. This operation which is performed with the Gun laid horizontally is effected by a machine in the following way: The Gun is fixed to the machine by a short piece of metal which is left at the end of the button bung made to fit a chink and on the muzzle end by a collar. It is then put in motion at the same time a piece of steel of the proposed size of the bore is progressively pushed towards it by means of a cog

cog wheel at the other extremity of the machine and the perforation is gradually carried on untill they arrive at the place for the Chamber when other bits are substituted according to the proposed nature of the Chamber Whilst the boring is going forward and a man is employed in turning the exterior of the Gun which is done in the usual manner of turning: The Gun is now powdered by which is meant the boring out a piece of the metal of about an inch or rather less in diameter and inserting in its place a copper screw through the Vent is bored and the ends of it are smoothed down to meet the surface both inside and outside

Before any thing more is done the Gun is proved and if it is found correct in every respect it is taken back to the work shop to have the trunnions cut which is done by a machine worked by two men: That part between the trunnions which could not be turned is then filed and Christed to its proper shape and size after which it is taken to the engraver for the ornaments

Elevation of a BORING MACHINE

Plan of a BORING MACHINE

Proving Ordnance

Proving and examining Ordnance The first part of the proof which a piece of ordnance undergoes is being fired with a regular Charge

Light 6 and 3 ^{Pr} are fired 3 times: between each round it is carefully examined with an instrument called a Serche

The following are the proof charges for Brass and iron Ordnance

Nature		Brass	Iron
	32 ^{Pr}	"	21 1/2 lbs
	24		18
	18		10
Med	12	6 lbs	12
Heavy	12	5	
	9	3 1/2	
Heavy	6	3	
Light	6	2	
Heavy	3	1 1/2	
Light	3	1	

Weight of Shot
16 1/2 lb

Iron Guns are fired with two wads after it has been ascertained that a piece of Ordnance has not suffered any damage with respect to the expansion of the bore &c from the above proof the water proof is then used

This is to discover whether there are any flaws in the metal which could not be detected with these instruments

The muzzle is then stoppered up closely by a conical plug through the center of which passes a pipe leading through a common water engine the pump is then worked till the bore is filled with water upon which there is a pressure from the condensed air in the Engine of about 15 lbs on the square inch

A cock is inserted in the Vent to let out the air as the bore is filling with water

If the Gun is porous in any part the surface will be found wet in consequence of the water being forced through

The examination after the Proof is performed by an instrument consisting of two long steel bars moving parallel to each other which is put into the bore of the Gun whose sides ought to be in contact with each other throughout

another instrument is passed down the bore to discover any deviation from the line. It has two small wheels: one running against the inner part of one of the bars and the other against the opposite side of the bore: to the latter a spring is attached which keeps it constantly extended if there be any deviation from the true line this spring by expanding or contracting acts upon a long brass bar which moves a hand on a graduated circle at the other end of the instrument.

The action of the spring is so multiplied that a deviation of $\frac{1}{16}$ of an inch in the bore is shown by an arc 2 inches in length on the index.

Parallel to the steel bars is a brass slide having notches at each side: a piece of silk is stretched from the base ring to the furthest of these and the slide moved till the silk falls into the other it will then be parallel to the axis and the distance of the metal from it is easily measured from which the thickness is found.

This method of examining

can only be used in Guns without a Chamber
for Mortars &c a different one is employed

A plate of brass the same size as the bore
is put in being supported by props to make it
stand in the Centre. The edge of the plate
is covered with wax for about an inch in
breadth

A small wheel at the end of a
long bar is passed along the sides of the bore
of which a point at the centre of the wheel traces
an exact representation on the wax and conse-
quently points out any defects

Light is reflected from the sun into the bore
of the Gun by means of a mirror in order to
discover any defects

There are certain limits allowed
for elevations in the bore in the length &c which
if exceeded the gun is rejected

The Theory of the Tangent Scale

Let B M represent the line of Metal on a cylindrical piece such as a Howitzer because for the present all considerations of dispart will be avoided so as to render the subject more simple

When the Gun is to be elevated the tangent scale so called from its being the tangent of an arc equal to that of the elevation is drawn up to a certain height. I B to the absolute length of the Tangent of elevation to radius. To M the Touch is then depressed

untill the top I of the tangent scale the muzzle
sight M & D the Object of an arc in a line
Now to prove that I B is the Tangent of an
angle of elevation I M the line of sight (vide
Fig' 2nd) is parallel to H D the original direct-
ions of the axis of the piece when laid point
blank at the object D. B & M the line of metal
intersects these parallels the angle of Elevation
A. C M is equal to its alternate angle. B. M. I
of which the scale B I is the tangent radius
B. M. C E D

To ascertain the actual heights
of the tangents of degrees and mark them on the
scale Multiply the length B M by the natural
tangents of as many degrees as is wanted
otherwise having) thus found the length of the Tan-
gent of one degree the first 6 or 7 may be consid-
ered as multiples of it as the differences of them
increase are so insignificant that in Practice
the thickness of the lines that mark off the
division would conceal them

In the Government work shops they
make all the divisions as the consequent error
of a quarter of a degree makes but little vari-
ation in the range when the Gun is placed at
so high an elevation as that of 15 degrees

The two Quadrants B.C.D.g. are set off on the base ring) C.O.g. on each side of it right. B The diameter C.g. is drawn as well the radius B.C which is of course at right angles to it and on this last the lengths of the tangents (found as before) of the 3 first degrees C^1 , C^2 , C^3 are marked the double ordinates S.s. S.s. S.s. given by their intersections of the Quadrants the points S.S.S. which are the extremities of the corresponding ones in question

The Natural Tangent of 1 Deg. is .0174551 another rule for obtaining the length of the Tangent of 1 degree is to multiply the length of the Gun in feet by 21 this of course is not quite so correct but it is more easily remembered.

Capt Devels Pendulum Tangent Scale

The usual method of laying a Gun is by looking along two notches one on the base ring and another on the swell of the muzzle which show the line of metal suppose A.B the plan of a Gun placed so that the object C fired at appears in the prolongation of the line A.B.

In Guns which have a dispart this can only be correct when the gun stands on a horizontal plane the line A.B then being in the same vertical plane with the axis of the piece. For if the gun stands upon an inclined plane the line A.B will no longer be in the Vertical plane passing through the axis of the piece which is that in which the shot passes but takes an oblique direction to it consequently the shot will cross the line by which the gun was laid

If the exterior figure of the gun were cylindrical instead of conical and it was laid by the line of metal when placed on a slope though the axis of the piece would not be in the same vertical plane as the line of metal it would be parallel to it and at a greater distance from it than the thickness of metal. consequently the path of the projectile would also be parallel to the line of metal.

The Gun is next to be elevated which is done by Fixing the Tangent scale at the requisite number of degrees the Piece is then raised or depressed till object aimed at is line with the notch on the top of the Tangent scale and that at the muzzle. If the Gun should be on an inclined plane this will not give the true elevation for the perpendicular length for the Tangent scale $A.D$ becomes shorter this will at once appear evident from Fig 2nd as $A.D$ being inclined in fact only gives the elevation due to the perpendicular $A.D$

To provide against these errors Capt^r Dwell has invented a pendulum tangent scale which will always preserve its true perpendicular length however great the inclination of the ground may be.

By means of this Tangent scale a gun may be fired with precision even if the trunnions were vertical instead of horizontal and the elevation will likewise be correct.

In such a case no elevation could be given by the common Tangent Scale.

The pendulum Tangent scale has a sliding weight with a hole in the center and a notch in the top. The degrees are marked on it in the same manner as on the common

Tangent scale. It has an oval hole by which it is suspended on the front C fig. 1 which is turned crossways to keep the pendulum on and screwed into the breech as much below the base ring as its radius that of the muzzle ring. For Howitzers and pieces that

that have no dispart the periculum on
the continuation of the line of sight

Suppose an army in position on the top
of a hill

If an enemy advance in column to attack
either flank. the artillery should be moved
so as to gain a flanking fire which will
bring the guns on a sloping ground where
great accuracy will ensure from the
use of the tangent scale for the foregoing
reasons as the following calculations show
at a range of 100 Yards

Heavy $5\frac{1}{2}$ Inch Howitzer (Error to the Right or Left

Light do

9 Pounder

6 do

10° Elevation

do	20	do
do	6	do
do	9	do

and in firing on rocky sloping or bad roads at a column of troops the like errors will take place more or less according to the slope of the ground and the length of the range if not elevated

Two 5 1/2 heavy inch Howitzers will miss a column of 100 yards if the slope be 4° out of the horizontal plane and placed on a road in line the road being 25 feet wide and raised in the middle

Table of errors calculated for a 9 Pounder with round shot on uneven ground

Table of Errors Calculated for a 9P ^r with round shot ^{on} uneven Ground					
Inclin ⁿ of the Wheels	750 yards Line of Incl ⁿ	Errors in yards to Right or Left	1000 yards	Errors in yds	
5	1° 12	1.34	2. 0	3	
10	1° 12	2. 7	2. 1	6	
15	1° 14	4. 2	2. 1	9	
1200 yards	Errors in yds	1300 yards	1450 yards Errors in yds	Errors in yds 1450 yards	Errors in yds
3°	5	4°	7	5	11
3°	4	4°	16	5	22
3°	14	4°	24	5	33

Remarks on the construction of Gun Carriages for Field SERVICE

In constructing Gun Carriages for the field service the most important considerations are strength, lightness, simplicity and uniformity in the corresponding parts of all carriages of the same nature in order that if required in the field any part may be at once replaced or exchanged. This is effected by making (previous to constructing a carriage of a new form) correct patterns of ^{the} wood work with gages and templates for the iron work after which by constructing strictly according to the patterns no material deviation can take place.

The wood should be well seasoned and the iron work made of several pieces welded together which is termed *lapped* and renders it much stronger.

For field carriages the Bed is made of oak the Cheeks or *hampers* of Elm: axletree Bed of oak the stocks or *naves* of the wheels of Elm the spokes of oak and the *Fillet* of oak the splinter bar and *Gutchells* of oak the Brackets behind of ash: Platform board

Names of the Several Parts of a Carriage

AB --- Brackets

BC --- Trail

D --- Trunnion Hole

E --- Eye bolts Keys & Chain

F --- Trunnion Plate

G --- Cap Square

H --- Lock Plate

I --- Port-fire Socket

K --- Bracket Bolts

L --- Traversing Stay

M --- Trail Plate

N --- Limbering Handle

P --- Elevation Screw

Q --- Traversing Hoop

R --- Axle-tree Bed

S --- Garnish Arreiles

T --- Nuts to the Bolts

V --- Axle-tree Bed

U --- Match or Shot Box

X --- Body of the Arm

Y --- Linch of the Arm

Z --- Advanceeel Chain

a --- Wheel Chain

b Steeples for Side Arms — c Champher of Pin & Chain

o Trail Piece Eye

Names of the Several parts of a Limber

A--Ammunition Box	I--Steer
B--Guard Iron	K--Shaft
C--Axle-tree Beel	L--Lumber hook
D--Lip of Beel	M--Key
E--Tutcheil	N--Yoke hoop
F--Foot board	P--Axle-tree
G--Splinter Bar	Q--Prop Stick
H--Shaft Socket	S--Platform

board of oak Foot board fir or elm Popstick ash
Shafts ash; Ammunition Box ends elm; remain-
der fir

In four wheeled Carriages the weight
should bear equally on all the wheels but when
a shaft is used in place of a pole, and
sweeping bar; it is necessary to throw the
weight further back in order to save the shaft
horse, which in going down hill has an almost
overpowering weight to resist; Carriages may be
constructed with a pole and travel better
on level roads The weight in going down
hill is divided between the wheel horses
but against these advantages must be placed
the time which is lost in unlimbering or the
reverse

The sweeping bar keeping the gunners at
a distance from the pivot tail and prevent-
ing them from exerting their strength at the
point required and as celerity in coming
into action or retreating is of the first im-
portance the advantages obtained by the
present construction of limbers far surpasses
those which would arise from substituting the
the Pole and sweeping bar

Upon viewing the construction on its several bearings it appears and is allowed to combine those points which are essential for carriages in field service.

Carriages for battering teams or cannon service are made entirely of oak: strength being required as the first consideration.

Limbs for battering teams are made of ash except the bolsters and axle tree box which are made of Elm.

Remarks on the construction of WHEELS

have

The nave or stock which is made of Elm is first bolted and hooped; mortices are then cut into it to receive the ends of the spokes which are to be driven firmly into it; great nicety is required to direct the spokes in such a manner that they may be when driven home form an angle with the nave which is called dish.

This angle is regulated by the dimensions of the wheel: half an inch being generally allowed for each foot of the diameter in this state. The wheel is called a *speck*

The spokes are of oak the fellys ash 12 of the latter are required for each wheel; mortises are then to be cut in the fellys to receive the ends of the spokes and a circular hole cut each end to receive the clowling pin.

Is a cylindrical piece of wood one inch in diameter which enters the ends of each contiguous felly and prevents them slipping.

The fellys are to be gradually driven on the ends of the spokes all being put on at the same time: care being taken that the clowling pins are properly placed; the ends of the spokes are now split and a wedge driven in to secure the spokes and fellys together in this state the wheel is said to be on the wedge and is left some time to season.

To prevent the clowling pin splitting the fellys large nails are driven through the sides of the fellys close to each end of the clowling pin; the tire is then put on in six pieces called streaks for the purpose of taking off any part that wants repairing.

They are put on hot, and by their contraction in cooling bind the felly closely to each other each stave by 4 bolts driven through the felly and screwed on the inside by a nut one near the end of each stave and the other two close to the bolt which screws the end of the clamping-pin also two large nails near the spoke on the end next to the end of the stave

The axle box is generally made of gun metal it is hollowed out in the centre about the 8th of an inch deep in order that the arm of the axle may only bear for about three inches upon each end of the box; this saves much friction and the hollow serves as a repository for grease

The object of marring wheels disk is to strengthen them against a lateral pressure which they are subject to for instance when one wheel is elevated

in going over any obstacle more than one half the weight is thrown on the lower wheel in a direction to strain it and force the nave or spokes outward to counteract this the spokes are placed at a small angle with the nave with which they unite and form several props meeting they resistance and counteracting the lateral pressure

The set of a wheel is caused by bending the extreme arm downwards this done in order to make the spokes as they severally come under the axle, perpendicular to the nave; however this may add to the strength of the ^{wheel} ~~nave~~ it is certainly disadvantageous to the strength and probably, ere long will be laid aside

Construction of the Arm of the axle of a Light 6 Pounder

Construction of Heavy 6 Pounder Wheels

- A Tire Streaks
- B Felly
- c Stock Hoops
- D Axletree
- E Box for Wheels
- F Tire Bolts
- G Rivet

- H Tire Nail
- I Dowling Pin
- K Spoke
- L Nave or Stock
- M Washer
- N Linch Pin

Draw the Horizontal line AB through the point E from which the axis of the arm declines.

Take EB equal to 13 inches and Draw BC at right angles to it $= \frac{1}{2}$ of an inch and Draw produce it to H which will represent the axis of the arm; through E Draw DF at right angles to CH and make ED, EF each to $1\frac{1}{16}$ inches;

Take EH equal to 13 inches and through H draw IK at right angles to it, HI, HK, each $= \frac{1}{32}$ inch; join ID, DK and the arm will be complete to the washer

Construction of the arm of the axle of a Heavy 6 Pounder

The line EB = 14 inches BC = $1\frac{1}{2}$ inch EH = 14 inches ED = EF = $1\frac{1}{16}$ inch
HI = HK = $1\frac{1}{32}$ inch

18. *Poumcler*

EC = 19 inches DF = $3\frac{1}{2}$ IK = $2\frac{1}{2}$ EH = 16 inches (length of the box)
 CH = $\frac{5}{8}$ of an inch DO = $\frac{7}{10}$ of an inch

24 Pouter

$EC = 20\frac{3}{4}$ inches. $DF = 3\frac{3}{4}$ inches $IK = 2\frac{3}{4}$ inches $EH = 18$ in
(length of the box) $CH = 5\frac{1}{2}$ of an inch $DO = 1$ inch

Dimensions of Axletrees for Travelling Carriages

Carriage	Length of Axletree	Length of Bed		Length of Cam of W		Diameter of Body		Diameter of Linch Pin			
		Feet	In	Feet	In	Feet	In	Feet	In		
Iron Orcl	{ 24 P ^r or 10 Inch Howitzer 24 P ^r of 6 Feet, 18 P ^r and 12 P ^r of 8 Feet and 8 In. Howitzer 24 P ^r Howitzer of 6 Feet or 9 Pounder 12 P ^r Mecl. or Light 9 P ^r & 6 P ^r Ho ^r 5 1/2 in How H ^r & 24 P ^r How 5 1/2 in How. L ^r 12 P ^r How / 3 P ^r L ^r & 4 1/2 Inch How) 3 P ^r 1 P ^r and 4 1/2 Inch How. Mecl 24 P ^r of 9 1/2 feet or 6 1/2 feet 18 P ^r & 12 P ^r of 8 Feet 10 or 8 in How 24 P ^r How, 12 P ^r of 6 Feet and 9 Pounder	6	7 1/4	3	1 1/2	1	6	"	3 3/4	"	2 2/3
		6	4 2/3	3	3	1	4	"	3 1/2	"	2 1/2
		6	5	3	7	1	2	3 1/3	"	2 1/6	
		6	3	3	8	1	1	"	2 3/4	"	1 3/4
		3	1 1/2	1	4 1/4	"	9	"	1 1/2	"	1 1/8
Iron Orcl	{ 24 P ^r 12 P ^r Howitzer Light and Heavy 5 1/2 In How How, 12 P ^r Light 9 P ^r Light 6 P ^r Light 3 P ^r Heavy 12 P ^r Medium 3 P ^r Light 4 1/2 Inch Howitzer & 1 Pounder	6	2 1/2	3	4 1/2	1	2	"	3 1/8	"	2 1/8
		* The same as Light 6 Pounder Carriages The same as 6 P ^r Heavy Carriages The same as the Carriage									

{ 24 P^r or 10 Inch Howitzer
 { 24 P^r of 6 Feet, 18 P^r and 12 P^r of 8 Feet and 8 In. Howitzer.
 { 24 P^r Howitzer of 6 Feet or 9 Pounder
 { 12 P^r Med. or Light 9 P^r & 6 P^r How 5 1/2 in How H^r & 24 P^r How
 { 5 1/2 in How. L^t 12 P^r How / 3 P^r L^t 4 1/2 Inch How)
 { 3 P^r 1 P^r and 4 1/2 Inch How. Med
 { 24 P^r of 9 1/2 feet or 6 1/2 feet 18 P^r & 12 P^r of 8 Feet 10 or 8 in How
 { 24 P^r How. 12 P^r of 6 Feet and 9 Pounder
 { 24 P^r 12 P^r Howitzer. Light and Heavy 5 1/2 In How
 { How. 12 P^r Light 9 P^r Light 6 P^r Light 3 P^r Heavy
 { 12 P^r Medium
 { 3 P^r Light 4 1/2 Inch Howitzer & 1 Pounder

Description of the Classes of Limbers & Wheels

Wheels

1st Class 12 P^r Gun and Limber 9 and Heavy 6 Pounder Guns Heavy 5½ to 24 P^r Howitzers have the heavy 6 P^r wheels

2^d Class. The 9 and Heavy 6 P^r Limbers light 6 P^r Gun and Limbers Heavy 5½ and 24 P^r Howitzer Limbers; Light 5½ Howitzers and Limber, and 12 P^r Howitzer and Limber have the light 6 P^r wheel

3^d Class. The Light 3 P^r to 4½ Howitzers have the 4 feet 4 inch wheel

4th Class. The Mountain Service 3 P^r 4½ How^r to the 10 P^r have the 3 feet wheel

The ammunition waggons have the wheels as the Limbers of the Guns

Limbers

1st Class, 12 P^r Gun and Wagon

2^d Class. The same is used for the 9 Pounder Heavy and Light 6 P^r Heavy 3 P^r 4½ & light 5½ inch Howitzers; 24 and 12 P^r Howitzers

also for the Gun ammunition Store & Forge waggons
and wheel Carriages

3rd Class, Light 3 P^{rs} and 4 1/2 Howitzer

The Mountain Carriage for Service have shafts
only

4th Class The small ammunition Wagon and
Lumber

Shafts

are the same for all nature of Field Guns above
the Light 3 P^{rs} which as well as the Mountain
Service Carriages are each of a different description

Dimension & Weight of Wheels

Char ^t	ft	in	wt	q ^{rs}	lb	ft	in	lb	q ^{rs}	lb
1 st	5.0	—	4.0	—	26	Platforms Car	5.0	—	5.2	7
2 nd	5.0	—	3.2	—	1	Low	4.0	—	4.2	2
3 rd	4.4	—	2.0	—	15	Devil Carriage	7.0	—	11.0	24
4 th	3.0	—	0.3	—	14	Slung Cart	5.6	—	8.1	13
24 P ^{rs} & 10 In How	5.0	—	8.1	—	10	Flank Wag ⁿ	5.0	—	3.2	1
18 P ^{rs} & 8.50	5.0	—	6.0	—	13	Low	4.2	—	2.3	20
Lumber to the above	3.10	—	3.2	—	10	Hand Cart	4.4	—	2.0	15

Axle trees,

Vary in the construction of each nature so that
the heavy and 6 P^{rs} wheel will not fit the
axis of the Light 6 P^{rs} axle

REPOSITORY COURSE

Exercise of Heavy GUNS on Garrison Carriages

- 1 Commands, points and directs
- 2 Searches; sponges and rams home
- 3 Loads and assists to ram home
- 4 Runs up and elevates
- 5 Runs up elevates and brings up ammunition
- 6 Primes serves the vent runs up and hammers
- 7 Runs up traverses and fires

The Guns may be served by reduced numbers and when this is the case the duties are performed as in the following table.

no of men	Command & Points	Sponges & rams home	Loads & assists to ram home	Runs up	Elevates	Traverse	Serves the vent & Primes	Fire	Brought up ammunition
8	1	2	3	4. 5. 6. 7	4. 5	6. 7	6	7	8
7	1	2	3	4. 5. 6. 7	4. 5	6. 7	6	7	5
6	1	2	3	2. 3. 4. 5	2. 3	4. 5	4	5	5
5	1	2	3	5 2. 3. 4	2. 3	4. 5	4	5	3
4	1	2	3	1. 2. 3	2. 3	2. 3	4	1	3
3	1	2	3	1. 2-3	2 3	2. 3	1	1	3

When not performing these duties the even numbers stand on the right of the Gun and the odd on the left in line with the Limber and having their backs to the parapet.

When Loading the body must be kept well back with the arms straight so that if the Gun goes off the hands only may be injured.

In heaving the hand next the small end of the handspike is placed under it and the other over; the men taking care to heave together; when running up the handspikes are placed under the axletree; when traversing to the right the left handspike is placed under the bracket behind the rear axletree and the right under the rear axletree; when traversing to the left the reverse.

Heaving the Gun to the right or left bodily is termed Cross lifting and is done by placing the two handspikes on one side under the bracket and the other two under the axletree.

The Dack hook is used after every

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5 or 6 rounds to clear the remains of
the Cartridge

Exercise of Heavy Guns on Travelling Carriages

The duties of the several numbers are exactly the same as when the gun is mounted on a Garrison Carriage except that there being only two handspikes they are when the gun is running up double manœuvred by the numbers who would man the rear handspike in the former case.

The Gun is directed by the commander by means of a short handspike placed under the trail transom.

The Gun is run up by placing the thick end of the handspike over the spokes of the wheel (close to the felly) and under the bracket and pressing down the small end the men keeping their backs to the parapet.

The wad hook and spring are placed on jacks driven into the Battery on the right of the gun or in case of a sunken Battery on the beam.

Exercise of Heavy Guns on ^aTraversing Platform

This Exercise requires 7 men whose duties are as follows

- 1 Points. Commands. and directs
- 2 Searches Sponges and ram home
- 3 Loads and assists to ram home
- 4 hands up the wad hook and sponge to No 2 runs up and traverses
- 5 brings up ammunition runs up & traverses
- 6 raises the vent runs up elevates & primes
- 7 Runs up elevates and fires

This disposition made when the pivot is in the rear but supposing the pivot to be in the front or centre 6 and 7 traverses and 4 and 5 elevates When Loading 2. 3. and 6 stand upon the platform

The usual way of running up is by pinching which is done by small levers shot with iron and placed under the wheels with the round side downward

In firing a lock is used and in Priming besides the usual tube a little loose powder is placed in the cup of the tube & in the pan of the lock

Mortar Exercise

7 men to a 13 inch Mortar

- 1 Points and Commanders
 - 2 Sponges wipes the bottom of the shell uncaps the fuze helps to put in the shell runs up and takes out the sheepskin
 - 3 Brings up his own ammunition assists to put in the shell & runs up
 - 4 Brings up the shell runs up and traverses
 - 5 ----- do -----
 - 6 Seizes the butt runs up traverses & Points
 - 7 Runs up traverses and fires
- In a 10 Inch Mortar only 2 are required to put in the shell (viz) 4 and 5 & 2 & 3 do not run up

5 men to an 8 or 5 1/2 Inch Mortar

- 1 Points and commands
- 2 Spongers. wipes the bottom of the shell uncaps the Fuse runs up and takes out the Shepokin
- 3 Brings up ammunition & runs up traverses and primes
- 5 runs up traverses and fires

To lay a mortar it is necessary to have 2 pickets on the parapet. one placed nearly in a line with the centre of the platform and the other exactly between the first and the object to be fired at

The mortar is laid with a plumb line which should coincide when held up before the eye with a chalk on the mortar and the Pickets

The traversing is performed in the same manner as the Garrison Gun Carriages there being bolts instead of axles

Note 4 & 5 the vent brings up the shell traverses and Primes

Method of directing a Gun to a fixed object at Night by means of a directing bar

6 men are required for this service whose duties are as follows

- 1 Points Commands and directs
- 2 Springs with a rope sprunge; runs home assist to run home runs up with block and tackle and elevates
- 3 Loads. assist to run home runs up & elevates
- 4 Sees the Vent. prepares the tackle runs up traverses and Primes
- 5 Prepares the tackle runs up traverses and fires

6 Brings up the Ammunition to n^o 3

The Gun Carriage is placed over the directing bar which extends the whole length of the Platform and is fixed by a pivot close to the hunter; pieces of wood are nailed on the extremities on both sides of the bar thus forming a groove for it to run in

The Blocks and tackle for running the Gun up are fixed on loops on the rear extremities and on the hunter

To traverse the Guns blocks and tackle are used

one of the hooks being hooked to the directing bar; and the other to the end of the platform the same on the other side: if the Gun is required to be traversed to the right, the Commander holds the left rope in his hand stopping the Gun when it points to the object; if the Gun is to be traversed to the left the reverse

When the Gun is correctly laid the bar is fixed by placing the iron pin on each side of the bar and filling up the intermediate spaces between the pins and bar with wedges

To keep the elevation a line is chalked on the coin and stool, so that the Gun be laid as correctly as if the object could be seen.

This method of running up and traversing with blocks and tackle is used when you are under a storm plunging fire the men working close under the parapet.

Mantlets are sometimes used to screen the men and are hung up across the embrasure by slings hooked to a pin on each side of the embrasure.

Mantlets are made of a number of raw hides nailed together to the thickness of 1 1/2 inch. They are proof against musket bullets and grape shot.

The lower mantlet when the Gun is run up to the pin and let down immediately it is fired; this duty is performed by N^{os} 2 and 3.

Method of Changing a heavy Gun from its Firing to its Travelling trunnion boxes.

14 men are required for this service. The Gun must be limbered up if it is not so already. The Caposquans are

are taken off and the breech is raised with
handspikes to allow the coin an elevating
screen to be taken away

A long Lever is put into the muzzle
of the Gun and forced down in order
to put in a roller which rests on the
stool-bed and is used for the purpose
of making the Gun run easier backwards
and forwards

2 Dragropes are hooked round the lever
in the muzzle and they are managed by
6 men; another lever is fixed under the
former at right angles to it close to the
muzzle; both levers are managed by 4 men each

The Gun is lifted by the levers and
as soon as the trunnions are clear of
the cybotts. the men at the drag ropes
pull it backwards to its travelling
trunnions boxes the capsguards are then
replaced and Kegeed.

To replace the Gun. the roller is
placed under it close to the first

reinforce ring, the men lift the levers and bear them back as soon as clear of the cybolls the dragropes checking it when the trunnions are over the boxes and the Gun is let down into its firing position.

The cross lever in replacing the Gun is placed between the dragropes and the muzzle to prevent its slipping.

Exercise of the Triangle Gin for mounting and Dismounting Heavy Ordnance

The complement ^{of men} for working the Triangle Gin, is 11 and when carrying it 2. and 3 carry the pry pole 4 and 6 the right check 5 & 7 the left check 8 the winchlass and fid 9 and 10 the blocks and tackle 11 the handspikes 1 Commanders

In putting the Gin together 2. 3. 6 & 7 put in the bolt and shackle 8 the winchlass 4 and 5 bolt the cross bars on their own side while this doing 10 and 11 receive the blocks and hanging the triple block with the back of the hook to the pry pole

To raise the Gun 2. 3. 10 and 11 lift a handspike which is put through a ring near the foot of the pyrote, and walk towards the checks; 4 and 5 steady the checks with handspikes placed under the lower cross bar 7. 8 & 9 assist in raising the checks

In working a Gun 2. and 4 Man the right wheel facing one another 3 & 5 the left 6. 7. 8 and 9 Pull in the slack 10 and 11 Keep the Gun steady

In heaving 2 and 5 put their handspikes in the upper holes of the winchlass and bring them down as low as the knees 3. and 4 puts theirs in the winchlass and 3 gives the word fetch; upon which 2 and 5 clear their handspikes from the winchlass and 2 gives the word heave; when 3. and 4 bring down their handspikes and 2 and 5 take a fresh purchase 2 giving the word fetch and so on alternately till the Gun is raised a sufficient height; when 6 makes fast the slack and lowers the Gun when required either on its own Carriage or on a platform Carriage for travelling

- 1 Gin
- 2 Bells Gin
- 3 Gibraltar Gin

The Exercise of Bells Gin

This Gin is used for mounting or dismounting heavy Field Artillery and Canonades as it is of a light construction.

It consists of two upright posts fixed to axle-trees upon trucks; and a horizontal beam through which moves a vertical bar

with a hook at the bottom worked up & down by means of cross handles and tooth and pinion work; the tackle bar which is hooked to the vertical bar is lashed to slings passing round the Gun

A small rope is coiled round the cross handles on both sides and six pulling at these; the cross handles are turned round and the Gun raised

Exercise of the Gibraltar Gin

The wood work of this gin is the same as in bells gin with the exception of greater strength and instead of a vertical bar a windlass with Rack and Pinion worked turned by a crank; handle is fixed to one of the posts; the rope after passing round the windlass runs of the horizontal bar and down through the middle of it when it is reeved through 2 blocks one of which is hung to the horizontal beam and to the other the tackle bar is used

This Gin may be used for mounting or Dismounting Heavy Ordnance on

Garrison Carriages; for this purpose it is drawn over the Gun when 2.3.4 and 5 lash on the tackle bar in front and rear of the turnions and keep the Gun steady 6 works the wheellass and 7 hauls in the Slack

Method of mounting or Dismounting Heavy

Ordnance by main force on a Garrison Carriage

Two ropes are hooked on to the Carriage one to the axle tree stay and the other to the rear eyebolt; they are passed over the Gun and manned at the same time 4 men with handspikes placed on the Carriage; on the other side assists in overturning it. The Gun by this means will be thrown out of its Carriage and the Carriage is then turned back into its proper position

To mount the Gun it must be placed with the vent downwards the Carriage is turned over upon it with the turnion boxes over the turnions and as there are no Cap-squares to confine the turnions the Gun must be lashed to the Carriage to keep them together when lifted up; the ropes are then hooked unto the Carriage and manned whilst the men at the handspikes assist

as before; when the Gun and Carriage are lifted up the lashings are taken off

Mounting a Gun on a Garrison Carriage by parbuckling on an inclined plane 14 men are at least required for this

The Carriage is placed on the Platform and the Gun on the ground at a sufficient distance from the Carriage to allow the skids which are about 12 feet long to be placed on the top of the

Carriage one in front the ^{other in} rear of the trunnions box; the ends of the skids placed on the Carriage are bevelled whilst those on the ground being square the stool and coin should be placed there for the Gun to be rolled upon; a rope is then hooked to the axle tree stay in front and another to the rear eyebolt both ropes are brought over the top of the Carriage passed round the Gun and again brought over the Carriage

The ropes are then manœuvred and the Gun drawn up on the skids till it is near the Carriage when if the turnions are in a such a position that if the Gun was rolled over they would not fall into their boxes the Gun must be punctured round by hanging a loop called a gummert on the turnion through which a handspike is put. it is done by pressing down down the handspike, the ^{ropes} being kept tight, so that the Gun turns on its own axis without advancing or losing ground.

When the Gun is sufficiently adjusted the ropes are shifted to the side of the Carriage and passed round the Gun to prevent its falling too quick into its place.

A piece of wood is laid across the brackets to receive the breech, for without this the superior weight of the breech would prevent the turnions falling into their boxes.

Method of mounting and Dismounting heavy Guns by means of Danseys boxes

Two sets of boxes are required for this, each set consisting of 5 boxes of the respective heights of 16. 12. 8-4 and 2 inches, two collars are also required to prevent the Gun rolling; one lashed in front and the other in rear of the trunnions

10 men are required for this service 8 of whom man a long lever which is put in the bore of the Gun whilst the other two shift the boxes

When the Gun is to be Dismounted the collars are first tied on and a set of boxes is placed under the front collar and close to the breast of the Carriage the men on the lever bear down till the breech of the Gun is sufficiently high to allow the Carriage to be run from under it the other set of boxes is then placed under the rear collar to same height as the front set

To lower the Gun they beer down the muzzle and a box is withdrawn from the rear set after this the muzzle is lifted up and a corresponding box withdrawn from the front and so on lowering it about 4 inches at a time till it reaches the ground

In mounting a Gun the operations are exactly the reverse and when the Gun is sufficiently raised the rear set of boxes are taken away the Carriage is run under the Gun and gently lowered into its place

These boxes may be used when you do not wish your movements to be seen on the parapet which would be the case if the Gun is used

The boxes take their name from the inventor Cap^t Dansey of the Royal Artillery

Method of Mounting a Mortar by main force

14 men is the Complement

4. 5. 6 and 7 each put a handspike in the muzzle of the mortar 8 & 9 fasten the chains of the dragropes round the ends of the handspikes: and the 2^d man the ropes pulling the mortar Verticle; the Caposquares are taken off and the handspikes out, the Chains are linked together round the muzzle of the Mortar, which is hauled over on its face;

To mount it the Bed must be turned round fronting the mortar; the drag ropes are fastened one on each trunnion and manœuvred by all the numbers except 4. 5. 6 & 7 who place their handspikes under the Dolphins of the Mortar in order to lift it when it is Verticle the caposquares are put on and the Com put in

To mount a Gun and Garrison Carriage on a Platform Carriage

Fourteen men are required for this

The gun is first raised off its Carriage with the Gin and the Carriage drawn away drag ropes are then fastened to the Platform Carriage which is drawn under the Gin and the gun lowered upon it; it is then drawn away.

The gun Carriage is capsizeed and raised by means of the gin sufficiently high to allow the Platform Carriage with the Gun upon it to be drawn under the Gin. which being done the gun Carriage is lowered upon it and secured by ropes attached to rings on the sides of the travelling Carriage by passing them over the axle and through the rings two or three times and making a half hitch

The handspikes and levers are pushed in between the Carriage and the rope

The coin and bed of the Garrison Carriage are put on top and it is then in travelling order

Method of Conveying Heavy Ordnance on a Devil Carriage

The Devil Carriage is used for transporting heavy ordnance a long distance and has the great advantage of requiring nothing else to enable you to mount a gun and Carriage upon it. They must be first caparozed then raise the gunnison Carriage upon its breast and shift it forward till it is quite clear of the turnions the Devil Carriage is then run back till the rear axle tree is over the turnions; the perch is raised perpendicular by the chagropemen; the guy

ropes being fastened at the end of the perch
and the preventive ropes to rings in front
of it and kept steady by the dragropes
and preventive men in front the Perch
men behind: the wheels having been previ-
ously stopped with wedges, the Garrison
Carriage is lashed to the Perch, at the
same time the Gun is shing under-
neath by a chain in front of the trunnions
the Perch is then pulled down by the
preventive men and one side of the
dragrope the other being in rear to prevent
the perch falling too fast; the perch is
keyed, the front axle-tree is of the Garrison
Carriage is lashed to the rear axle-tree
of the Devil Carriage; the Gun is depressed
at the muzzle by a handspike placed
in the bore, till the perch is lashed to
the breech. The handspikes are laid
along the Carriage and the Car. Stool-
bed &c are packed in the inside it is now
fit for travelling

Appertinances to a Devil Carriage

2 large chagropes
a Dragrope of 12 fathoms
a preventive rope 9 fathoms
A Carriage rope of 3 fathoms
A breech rope 2 1/2 fathom

} 2 1/2 in.

A Chain 4 short handspikes and one large
one 16 men and one Non Com Officer are
usually tolled off to perform the Duties of the
Devil Carriage

They form upon the right and left
of the Carriage the odd numbers on the
left and the even on the right; from
2 to 9 are called chagrope men from
10 to 15 are perch men 16 and 17 are
preventive men 2 and 3 coil up the
chagropes. 4 and 5 put in the hand-
spikes 6, 7, 8 & 9 lash the front axle-tree
of the gun Carriage 10 skins the gun &
11 the Carriage 12 and 13 lash the breech
14 unkeys the draught Chain 15 the Perch
16 and 17 holds on the preventive ropes
and lash them to the rear axle-tree of
the Gun Carriage 10 & 11 stop up the rear

wheels 16 and 17 the front wheels, the non com-
 officer places a handspike between the
 spokes of the rear wheel to keep the chain
 close to the trunnions

The same with 8 men 2. 3. 4 and 5 are chaf-
 rope men 6. 7. 8 and 9 perch men 6 sling the
 Gun and 7, the Carriage 8 and 9 lash up
 the breech

A 13 inch Mortar and its bed each
 requires a sling Devil Carriage. The mortar
 is laid on the ground its mouth to the
 front the Devil Carriage is brought over ^{to} the
 Perch raised and a chain passed under
 the trunnions and fastened to the axle
 The Perch is then lowered which raises the
 breech a large fiddle is put into the mouth
 by which it is raised and lashed to the perch
 In slinging the bed the trunnions

is passed through the trunnion boxes

The other mortars are slung together with their beds and the Chain is pass round the body of the whole and in this case the rear of the bed is also lashed to the Pick

Slung Cart

6 men and one Non Com Officer told off 2 and 3 slings the Gun which must be laid with one trunnion on the ground

The Slings is passed diagonally round the Gun be carried before the trunnion and behind the other. and that end of the sling which passes round the other side (lower side) must be the end acted on by the Windlass. as by this means the trunnions becomes Horizontal when raised 3, 5 and 7 man the left two 2, 4, & 6 the right. Upon the word being given they heave together.

The left two holds on whilst the right is disengaged and takes a fresh purchase. The left then does the same and the both heave together.

When the Gun is raised high enough N^o 1 puts in the fall 2 and 3 takes

The levers out 6 and 7 put in the pry pole
and 4 and 5 raise the breech of the Gun
with their handspikes and 6 and 7 lash
it to the pry pole

The levers and spikes are then put up
and lashed to the pry pole by 6 & 7

To Shing a 13 inch mortar and bee
under Shing Carts

For this purpose 2 Shing Carts are
required the mortar is shing with to the
rear the Bee is shing to another in a
line with the centre of the trunnion boxes
and lashed by the front bolts to the pry pole
the coin is laid on the top of the Cart in front of
the windlass

Different Methods of conveying Ordnance
up steep Ascents when horses cannot
be used By Crab Capstans the Gun being
on a Travelling Carriage

A Crab Capstan consists of a
roller placed vertically in a frame round
which the rope is passed twice a man
sits down who passes the rope to the rear
as it is worked up to be coiled by another
the Capstan is secured by a rope which
is fastened to the stock and passed round
by the bottom of the frame it is worked
by long levers which are put through
mortises at the top at right angles to
each other

Before the gun is drawn up a
limber is placed at the top of the hill
to the wheels of which single sheaved
match blocks are fastened the ropes
are then first fastened at the top of
the hill so that they cannot slip
and the ends pass through the single

blocks fastened to the axle of the gun carriage and brought up again passed through the snatchblocks and twice when the Captains and held on by one of the numbers

By a Combination of pulleys as by applying a rope round the Circumference of the wheels the Gun being on a Hing Cart

Two blocks are hooked on to the Axle the a rope is run through each one and being fixed to forked lever

driven into the ground on the top of the hill and opposite the wheels the men pull at the other end

A greater Power may be obtained by fastening blocks and pulleys with any number of sheaves to the moveable end of each rope

This is done by means of salvages the power may also be used with greater advantage by making it act over the circumference of the wheels instead of the axle

Two men with blocks of wood are stationed ^{behind} the wheels to prevent the Cart losing any way it may have gained

By Parbuckling on skids or without them.

Lay the skids at a proper width down the hill and fixing another at a small distance beyond secured by chains to one sunk 5 or 6 feet in the ground two ropes are fastened to this skid, and taken down the hill and passed round the gun one at the muzzle and the other at the breech. The ropes are then marked at the brow of the hill, the odd number on the

left side and the even on the right the men pull standing still, passing the rope from hand to hand untill the gun by rolling over the skids arrives there: four men are generally told off to move the skids to the front as soon as the gun is off them and to keep the rope on the gun

Perbuckling without skids is done in the same way as with them but requires more men

To Embark and Disembark Ordnance with Shears

The shears are first lowered and a shap put on to which a double block is hooked a single one is also hooked to the shing round the mortar, or Gun as it is, requires a great number of men to raise the Gun in this way, another block is fastened to the bottom of the shears and the rope passed through it; the Gun is then raised and the shears lowered towards the raft untill the gun is clear they are held on and the gun

itself lowered. The Shears are surmount and lowered by means of Guy-ropes made fast to the pickets: the Gun may be raised by means of a temporary Capstan made by a light Lumber

Method of forming a temporary Crane with a 24 Pounder on a travelling Carriage and Lumber

A strong piece of wood is lashed across the end of the trail which is next raised and the Lumber run back. by this means the trail is elevated and projects beyond the Lumber

both are lashed together by gunnicks and
welding sticks

A block is fastened to each side of the
trail at its extremity and another to each
side of the Gun or Mortar to be raised
by slings

A rope is reeved through each pair of
blocks, passing through the lower one first
the end is secured to the front part of
the Gun. The men pull at the other end
and if there are not enough a further power
may be gained by attaching blocks & pulleys to the
ends of the ropes by means of lewagies

To Embark or Disembark Light Ordnance by
means of a Crane formed by 2 light 60' Ladders

First One Ladder with its rear to the bank and the box taken off the other Ladder is then brought up and the shaft carried over the first the ends projecting a little beyond it, they are then lashed well together. Two handspikes are also lashed to the ends of the projecting shaft and a single block fastened to each.

The standing ends of the ropes are secured by forked Levers driven into the ground

and the acting ends are passed under the
 Limbs through blocks fastened in front
 of the axle of the Gun Carriage and
 through the blocks at the end of the shafts

Method of Embarking Pontoons by making a
 temporary Crane with the Carriage

The Pontoon is first taken off the Car-
 riage and placed on the ends of the
 ends of the raft. The Carriage is then
 placed with its hind wheels opposite the
 center of the Pontoon. and a piece of wood
 is put in the rear axle tree bottom
 to give the baulks an elevation. The latter
 should project about 6 feet in rear of the
 wheels. The shafts are taken off and lashed

across the baulks. and the loop ends of the tackle falls, lashed round the end of the baulks and shafts

The rear ends of the baulks are lashed to the rear axle tree of the Carriage and the front ends of the splinter bar & sweep of "Limbs"

Two baulks are laid down the bank (if there be one) one at each end of the Pontoon and the ropes which are attached to the upper ends of these baulks are lashed to the ends of the Carriage after passing under the Pontoon.

Two gaskets are put round the Pontoon and the blocks being hooked to them the Pontoon is raised up and the Carriage being run a little forward, the Pontoon is allowed to slide down the inclined plane formed by the baulks.

To Embark light field artillery by means of Dragropes

If the bank is not very steep two drag-ropes are hooked unto the trail and 2 preventive ropes to hooks on the axletrees and it is lowered to the raft

In the Limber a dragrope is hooked on to the uncj on each shaft and a turn taken near the end to prevent them plunging up the ground and the preventive ropes on the Limber hook

To form a Temporary Darg of a Devil Carriage, to Embark or Disembark Ammunition

Two Levers are lashed across it one over the top of the rear wheels, with its centre resting upon the perch.

Four baulks are laid over them one on each side and two in the centre. Their ends are lashed to the splinter bar four

Chesses are laid upon the top of them

This way is only used for landing small stores and ammunition

Method of Mounting or Dismounting Heavy field Artillery without Guns

In order to perform this 8 men & a non Com^d officer are required. A hole is dug in the ground to receive the muzzle the gun is pulled over the hole. The wheels are stoppered and the trail is pulled over by means of chagrines fastened to the Limber 4 men lifting at the trail the muzzle being lifted up the Capsquams are unkeyed and the elevating screw taken off.

To move Heavy Field Artillery along steep banks or hills without danger of upsetting)

This is done by attaching chagrines to the Carriage and Limber and by the men pulling in a contrary direction.

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Method of Conveying Field Artillery off the
Field when the Carriages are disabled

If piece of either or both wheels be shot
away the gun is dismounted and slung
under the Limber and the wheels locked
by chagropes to the trail of the Carriages

Or if one wheel be too much disabled
to allow of this two handspikes are lashed
across the Carriage and one of the shafts
of the Limber is taken out and inclined
so as to support the axle tree arm to which
it is lashed and be itself supported by
2 cross handspikes

The weight of the Limber is equally
divided between the two horses by lash-
ing a wact hook and spring to the
Centre of the remaining shafts so as to
act like a cross bar in a Curicle

Another way is to disengage the Carriage
from the wheels and having first turned
it over lay it upon the top of the limber
and secure it with chagropes the wheels may
ride on the top of the wheels

Method of placing limbers to protect Artillery
men from being charged by Cavalry in
narrow rows —

The shafts of the Limbers and Ammunition
waggons are lashed together in a
line. the ends being pointed together. Then
the wheels of one waggon being placed
against the wheels of the next limber. it forms
a line behind which the Guns are placed
and are fired over the shafts —

To change the front of a Brigade of Artillery in a narrow passage; the horses are taken out; the Guns and Ammunition limbers are unhitched and each turned round on its own ground

The Guns are limbered up to the Ammunition Cars and if there is no spare limber to attach to the Gun in front it may be drawn off by dragropes fixed to the axletrees

To lay a Bridge of Ten Pontons including the mounting or Dismounting them from their Carriages

The bank on each side where the ends of the bridge are intended to be must be cut away and made firm by fascines or otherwise

One end of each shearline must be taken across the water and fixed to Pickets the distance between the pickets must be the length of a Ponton the shear line must then be hauled tight by means of a Capstan and then made fast

The boats being numbered are then launched each leaving ^{on} board a Non Com Officer and 4 men with the necessary ropes &c

The anchors beginning with No 1 next to the shore are then to be dropped 22 yards or more according to the depth of the river from the sheer lines to which they are lashed by rings and small ropes at the end of the Pontoons

The space between each Pontoon is about the breadth of one which is 4 ft 10 inches. This however varies according to the strength required

The spring lines are then lashed diagonally from the rings of one Pontoon to the side of the next, in order to brace them tight a Chess should be laid at each side of the bridge (bottom upwards) These serve to lay the end of the baulks on which are then laid across the Pontoon

The gang boards are laid across the heads and stems of the Pontoons from one

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side of the river to the other which gives the
men footing to lay the Chesses across the baulks

The Gang boards are then laid across the
ends of the Chesses on each side and picked
down

To form a swing bridge formed of a raft made of Pontons

The raft consists of two or more Pontons lashed together and planks laid over them. A sheer line is fixed across from bank to bank and a running block attached to it. A rope is reeved through the block and the ends fastened to the raft.

To draw it from either side to the other two ropes are attached to the ends.

This bridge serves for the transport of Light Ordnance &c

To make a Trough Bridge

This bridge is used for Field Artillery to pass over small ditches.

One trough is first laid if possible halfway or more across the ditch and supported by men standing on the end.

Two dragropes are attached to the two rings at the end and 2 men jump with them to the other side.

They are then crossed under the trough and the men pull it across; the other troughs are slid over this and laid on each side. To increase the strength of

of the bridge a small beam may be lashed under the trangs across the center

Upi Bridge

Is used for crossing the ditches of field works it is made as follows

The shafts of the timber of an ammunition Waggon are taken out and two spars are lashed perpendicular to the axle-tree in their place

Two long poles are lashed to the axle-tree on each side, having a small inclination upwards and guy ropes run from the top of the upright spars to the extremities

To prevent these long poles closing upwards two horizontal spars are lashed across the center one on each side

Handspikes are lashed across at short distances which serve as steps for the men to cross over. Two ropes are passed along the bridge one on each side they are made fast to the guy ropes and are to assist the men while crossing

In using this bridge the wheels are run into the ditch one end rests upon the escarp and the other is supported by the Counterscarp

To Draw Field Artillery through Rivers where there are no Methods of making a Bridge

The Gun is unlumbered a wad put into the mouth and the vent stopped a rope is fixed to the breech of the gun and passed under the breast of the Carriage forming the loop there. Another loop is attached to this loop and the end carried to the other side of the river by which it is drawn through

To Enlatch Walls with scaling ladders and different ways of pulling them together to form a bridge for infantry

For this purpose a number of small ladders are used each about 5 feet long with projecting ends. it is narrower at one end than the other end, ^{at} the foot

a broad end are two iron staples through which the narrow end of the next ladder is to pass

The ladders are lashed together by ropes fixed to the upper bar on each about the centre of the ladder two pieces of wood called wings are attached: which resting against the wall increase its strength by diminishing the strain two guy ropes are attached near the top of the ladder to keep it steady

These ladders may be put together on the ground and used as a bridge in this case it must be strengthened by ropes four of which are tied to the top of the

Ladder on each side: Two are passed through each end of the rings and fastened to the bottom and they are then twisted tight by means of winding sticks

Firing with red hot shot

The shot are taken out of the grate with pincers and placed in an iron frame called a bearer which has 2 handles by which it is carried up to the gun and the shot put in: between the shot and the powder a wet wad is put in and as soon as the shot is home the gun is fired.

7 men are required whose duties are as follows

1 Points Commands & Fires

2 Sprunges. runs up traverses & elevates, if the grate is to the left of the gun he will assist to put in the shot if to the right primes.

3 serves Cartridges and wads. runs up traverses and Elevates if the grate is to the left of the gun primes if to the right he will assist to put in the shot

4 serves the vent runs up brings shot and assists to put them in to the gun if the grate is to the right; if to the left gives the handle of the beam to N^o 3

5 runs up brings shot and assists to put them into the gun if the grate is to the left; if to the right gives the handle of the beam to N^o 2

6 Brings Cartridges to N^o 2

Note. the gun is turned before the shot is put in

The Theory of pointing Guns explained by a dissected Field piece

The usual method of laying a gun is by applying the eye to a notch cut on the top of the base ring corresponding to one on the muzzle and moving the trail. The object aimed at appears in line with the two notches. The eye is next applied to the quarter sight the breech raised or depressed till the object appears in the same plane as the line denoting the quarter sight

Now if the breech of the Gun be sawed off
and a flat circular piece of metal with
a small hole drilled in its centre, fixed
in its plane and another piece at the muz-
zle; with a large hole; across which are fixed
two pieces of silk at right angles to each other
the imaginary line joining these centres
will be the axis of the piece and consequently
the true line of direction

Therefore if a Gun laid in the before
mentioned manner brings the object in the
continuation of the axis of the Piece as it is
found to do; it evinces that the method
is correct. In the Repository at Woolwich
there is a Gun with the breech cut off for
the Purpose

Measuring Distances

With a small rope and 4 pickets suppose A. B the distance required to be found: measure off any length A. D perpendicular to A. B. and D. E Perpendicular to A. D

Then observe when the line E. B cuts A. D and measure the distance C. D. By similar Δ 's $C. D : D. E :: C. A : A. B$ consequently A. B is $= \text{to } \frac{DE}{CD} C. A$ — — — — —

Method of determining the distance of any fixed object from two stations

Suppose A and B to be fixed stations the distance between which is known and it is required to find that of any object C
First the direction of the object from

from each station is to be taken which is
done by means of two brass bars A.E.C.D the
bar A.E has two perpendicular wires to
direct the sight and D.E may be lengthened
or contracted by means of a screw and slide
at the point D it is then to be referred to a
similar base a b. a c. h c one each = to A D
and E B. the bars A.E.C.D are moved &
fixed to the base a.c. consequently f a is
parallel to the direction G.A in the first
case and the same is done for the other
direction h.g the prolongations c.e. a.e. b.g and
their intersection at the point c being
taken with two pieces of silk are referred to
the same scale as the reduced base h a and
will give the measures of AC and BC to
which they are perpendicular

- 1 Reef Knot-
- 2 half Hitches
- 3 Sheep Shank
- 4 Single bowline
- 5 Timber Hitch
- 6 Clove Hitch
- 7 Cats Paw
- 8 Commencement of a Double Bowline
- 9 Double Bowline
- 10 Shings
- 11 Dagsrope hitch
- 12 Hawser Bend
- 13 French Protony Knot-
- 14 Mens Flawless Hitch
- 15 Weavers Knot
- 16 Wall Knot
- 17 Pair of shings on the Single of a Rope
- 18 Fishmongers Bend

List of the different pieces of Ordnances used in the British Service

Iron Guns	Length ft. in	Weight Cwt	Use &c
68 ⁷⁰			Millen. At present two assigned for the lower deck of each 2 ^d rate
42	9. 6	63	Obsolete. There may be some in gunboats
32-	9. 6	55	Lower deck of a line of Battle ships also in sea batteries
32-	8. 6	50	Not used in Service only six in the Arsenal at Woolwich
24 -	9. 6-	5-0	Middle deck of 1 st rates and main deck of some 4 th rates also in Fortresses ^{Battering trains}
24-	8. 0	43	Not used too in the Arsenal at Woolwich
Bloomfield 24-	7. 6	40	Appropriated to the upper deck of 1 st ship only; the Donayal
Corywies 2-4	7. 6	42	Upper deck of a first rated frigate and fore-castle of 2 nd rates
2-4	6. 6	33	Not used at present
24.	6. 0	30	Not used at present
18-	9-0	42	Upper deck of 74 Gun ships ^{Gunns} and Battering trains
24	9. 0	47	Upper deck of 2 nd rates lower of some 4 th rates & gunboats Battering trains

<i>Iron Guns</i>	<i>Length ft. in</i>	<i>Weight Cwt</i>	<i>Use &c</i>
18 P.	8-0-	37	Main deck 46 & 42 Gun Frigates Garrison Battering train
18	6-0	27	Not used at present
12	9-0	34	Chase guns line of battle ships Garrisons
12	8-6	33	Garrisons Lewis & Batty trains
12	7-6	29	2 ^d deck line of battle ships Garrisons &c
12	6-0	28	Not used at present
9	9-0	31	Garrison
9	8-6	29	Do
9	7-6	26	Chase guns of Frigates and Garrisons Lewis
9	7-0	25	Garrison
9	5-6	22	Not used
6	8-6	23	Garrisons: but little used
6	8-0	22	Do
6	7-6	21	Do

<i>Iron Guns</i>	<i>Length</i>	<i>Weight</i>	<i>Uses</i>
6-	7.0	20	Canon but little used
6	6.6	18	Chase guns of sloops.
6	6.0	17	Not used.
6	4.10	12	Do
6	3.8	6	"
4	6.0	12	"
<i>Canonades</i>			<i>Uses</i>
68 Pr	5.2	36	Two on lower deck. till gun Mills 68 Pr guns are ready
68	4.0	29	Not in service
42	4.4	22 $\frac{1}{4}$	Upper deck in 4 th rates
32	4.0	17	Of a general use in the navy for annihilating 2 ^d decks & Forecastle also main deck of 4 th rates & large sloops
24	3.8	13	Not much used in the navy except for boats a great deal in Forts
18	3.3	10	Main decks of small sloops & in boats
12	2.8	6	Some cutters & boats & for flank fire in Fortresses
6	2.8	4 $\frac{2}{3}$	King's & Revenue Cutters

Brass Guns	Length ft. in.	Weight Cwt	Use &c
12P	8.6	10	Medium 12 P ^o excellent
12	5-0	12	light 12 P ^o might be of use in canons &c & Countries of different movement
9	6-0	13½	Field Guns much used
9	4.6	9	Obsolete
6	7-0	12	Long 6 P ^o . Good shooting but not good travelling gun
6	5.0	9	Not used
6	5.0	6	Light 6 Pounders. Cutters have 2 as Chase guns
3	6.0	6	Heavy or Long 3 P ^o .
3	4.0	3	For Colonial Service
3	3.0	2.1.2	Mountain Service
1	5.0	2.2.1	Colonial Service
5½ in	Brass Howitzers		
"	2.8	10	For Garrison
4½	1.10	2½	For Colonial
24 P ^o 5	4.9	12	Millars Proposed for 9 P ^o Batteries

Brass Howitzer	Length H. in	weight lbs.	Use &c.
4 $\frac{3}{8}$	3.8	6.2.3	Mellans proposed for a 60" Water
10 -	4.2	2.7	Do
8	3.4	14	Do
5 $\frac{1}{2}$	2.4	4 $\frac{3}{4}$	Do

Iron Howitzer

10 in	5.0	39.2	Mellans. Garrison train
8	4.0	20.2	Do
5 $\frac{1}{2}$	3.6	15	Not used but are good Garrison Howitzers
5 $\frac{1}{4}$	3.10	12	Do

Weights of Field Carriages

Nature of Carriages		No ^s of Rounds	Weight			Total			Remarks
			Cwt.	2 ¹ / ₂	lb.	Cwt.	2 ¹ / ₂	lb.	
12 lb.	Gun		18	"	"				
	Carriage		12	3	9	41	1	28	
	Lumber		8	3	6				
	Ammunition	12	1	3	8				
12 P ^r Ammun ⁿ Wagon	Carriage		13	1	21				Weight of each charge 17 lbs
	Lumber		8	2	11	30	1	15	
	Spare Shoes		8	1	11				
12 P ^r Ammun ⁿ Wagon	Body & Lumber		11	"	5				
	Lumber		8	1	5	30	1	2	
	Ammunition	72	10	3	20				
9 P ^r	Iron		13	2	"				weight of each charge 13 lbs
	Carriage		11	3	6	37	0	9	
	Lumber		8	"	17				
	Ammunition	32	3	2	24				
9 P ^r Ammun ⁿ Wagon	Body & Lumber		11	"	6				
	Lumber		8	"	24	29	"	2	
	Ammunition	84	9	3	"				
9 P ^r sphe. Wheel Carriage	Lumber		7	3	11				
	Spare Shoes		9	1	4	29	2	15	
	Carriage	"	12	2	"				
Heavy 6 P ^r	Carriage		11	2	4				
	Gun		12	1	16	35	1	17	
	Lumber		8	"	"				
	Ammunition	50	3	3	5				
Hvy 6 P ^r Ammun ⁿ Wagon	Body & Lumber		11	"	6				Weight of each charge 82 lbs
	Lumber		8	"	24	29	3	16	
	Ammunition	140	10	2	14				
Hvy 6 P ^r sphe. wheel Carriage	Carriage		11	2	4				
	Lumber		7	3	11	28	1	27	
	Spare Shoes		9	"	12				
Lt 6 P ^r	Gun		6	"	"				weight of each charge
	Carriage		8	3	6	26	1	19	
	Lumber		8	"	5				
	Ammunition	50	3	2	8				

Weight of Carriages for iron Guns and Howitzers and Beds for Mortars

		Nature of Ordnance	Travelling		Garrison		Mortar bed			Remarks
			Gun Car	Limbs	Wood	Iron	Sea Lumber	Land Do	Loc L	
		Pounder	Cwt	Cwt	Cwt	Cwt	"	"	"	Length 6 feet Length 6 feet 8 rounds of ammuni- tion carried between the cheeks W ^t of wheel is 12" 24 lb 8 Rounds of ammuni- tion carried between the cheeks W ^t of wheels 32" 24 lb The iron carriages are generally used for warm climates & in situations not much exposed
		42	"	"	162	29	"	"	"	
		32	"	"	15	22 1/2	"	"	"	
		24	24 1/2	17 1/2	13 1/2	20 1/2	"	"	"	
		18	24 1/2	7 1/2	12 1/2	17 1/2	"	"	"	
		12	12	16	"	"	"	"	"	
		9	11 1/2	6	10 1/2	14 1/2	"	"	"	
		6	"	"	9	15 1/2	"	"	"	
		4	"	"	"	7	"	"	"	
Howitzer	Iron	10 Inch	29 1/2	7 1/2	"	"	"	"	"	General Millers Howitzer
		8	22	7 1/2	"	"	"	"	"	
	brass	10	"	"	19 1/2	"	"	"	"	
		8	21	7 1/2	16 1/2	"	"	"	"	
Iron		24 7/8 How	11 1/2	6	"	"	"	"	"	
Mortars		13 inc	"	"	"	"	39 2 1/2	50		
		10	"	"	"	"	32 10	23		
		8	"	"	"	"	" 6	12		
		5 1/2	"	"	"	"	" 1/4			

Table of the Weights &c of Sharpnell Shells

Table of the weights &c	Charges			Quantity of bursting powder	Weight of shells when filled		10 ^{lb} of shells when empty		Nature of base	N ^o of balls		
Nature of Ordnance	lbs	oz	oz	Do	lb	oz	lb	oz			Thicker than	otherwise than
68 72 ^{lb} Canonades	5	12	15	"	59	8	32	"		395	9 1/4 in	6 1/2 in
8 in Howitzer	3	8	15	"	59	8	32	"		395	9 1/4	6 1/4
42 102 ^{lb} Canonade	3	8	7	8	35	12	19	4		240	7 3/4	5 1/2
34 70 ^{lb} Gun	14	0	7	8	35	12	19	4		240	7 3/4	5 1/2
32 70 ^{lb} Canonade	2	10	7	"	27	8	15	0		178	7 1/4	5 1/2
32 70 ^{lb} Gun	10	11	7	"	27	8	15	0		178	7 1/4	5
24 70 ^{lb} Canonade	2	0	6	"	20	1	11	1		128	6 1/2	4 1/2
24 70 ^{lb} Gun	8	0	6	"	20	1	11	1		128	6 1/2	4 1/2
5 1/2 inch Howitzer	2	0	6	"	20	1	11	1		128	6 1/2	4 1/2
3 1/2 L How	2	0	6	"	20	1	11	1		128	6 1/2	4 1/2
18 70 ^{lb} Canonade	1	8	5	"	14	13	8	15		95	5 3/4	4 1/4
18 70 ^{lb} Gun	6	"	5	"	14	13	8	15		95	5 3/4	4 1/4
12 70 ^{lb} Canonade	1	0	4	8	10	1	5	8		64	5 1/4	3 3/4
12 70 ^{lb} Gun	3	0	4	8	10	1	5	8		64	5 1/4	3 3/4
4 1/2 77 How	4	0	4	8	10	1	5	8		64	5 1/4	3 3/4
9 70 ^{lb} { Canonades	"	14	3	8	7	10	4	7		45	4 3/4	3 3/4
9 70 ^{lb} { Gun	3	"	3	8	7	10	4	7		45	4 3/4	3 3/4
6 70 ^{lb} { 42 Guns	2	"	2	8	4	14	3	0		26	4 1/4	2 3/4
6 70 ^{lb} { 2 Guns	1	"	2	8	4	14	3	0		26	4 1/4	2 1/2
3 70 ^{lb} 77 Guns	1	"	1	8	2	4.5	1	8.2		11	3 3/4	2 1/2
3 70 ^{lb} 2 Guns	"	12	1	8	2	4.5	1	8.2		11	3 3/4	2 1/2

Proportion of Ammunition for each nature of Field Artillery

Nature of Ordnance	Nature of Ordnance	Ayle ² box	No of Rounds	Gun Limber		Lumber Carriage			
				Off	Near	Lumber		body	
						Off	Near	fore	hind
12 Pounder Medium	Rounds	"	84	5	5	12	12	12	16
	H ^y Case	"		-	-	2	2	..	..
	L ^t Case	"		1	1	2	2	..	2
	Sph ^e Case	"							
9 Pounder	Rounds	"	116	13	13	13	13	12	24
	H ^y Case	"		2	2	2	1	2	..
	L ^{ig} ² Case	"		1	1	1	2	2	..
	Sph Case	"		..	..	..	..	12	..
H ^y 6 P ^o ₂	Rounds	"	190	20	20	20	20	25	35
	H ^y case	"		3	2	3	2	5	..
	L ^t case	"		2	3	2	3	5	..
	Sph Case	"		..	..	..	..	10	10
L ^t 6 P ^o ₂	Rounds	8	180	16	16	16	16	25	35
	H ^y Case	..		3	2	2	2	5	..
	L ^t Case	..		2	3	2	2	5	..
	Sph case	..		..	..	..	..	10	10
H ^y 9 P ^o ₂	Rounds	12	250	20	20	20	20	48	48
	H ^y Case	..		5	5	5	5	..	..
	L ^{ig} ² Case	..		5	5	5	5	..	..
		..		..	..	..	..	11	11
H ^y 5 ¹ / ₂ Howitz	Rounds	"	78	8	8	11	11	10	10
	H ^y Case	"		2	2	..	..	2	2
	L ^{ig} ² Case	"		..	..	..	..	2	2
	Sph Case	"		..	..	..	..	4	4
L ^{ig} ² 5 ¹ / ₂ Howitz	Rounds		84	8	8	11	11	10	10
	L ^{ig} ² Case			2	2	..	..	3	3
	H ^y Case			..	..	..	..	2	2
	Sph Case			..	..	..	..	4	4

Table showing the diameter of the bore and the high and low gauges of shot for different natures of Ordnance

Nature of Ordnance	Bore		Gauges of shot			
	Inches		High		Low	
			Inches		Inches	
42	7	018	6	795	6	684
32	6	41	6	207	6	105
24	5	382	5	639	5	547
18	5	295	5	124	5	040
12	4	623	4	476	4	203
9	4	2	4	066	4	
6	3	668	3	332	3	498
4	3	204	3	104	3	053
3	2	913	2	82	2	775
2	2	544	2	463	2	432
1	2	019	1	995	1	923

Table of the Charge Elevation and Fuse for firing Spherical shot

Range	24 Pounder			18 Pounder			Medi 12 P ^r			Light 12 P ^r		
	Charge	Elev ⁿ	Fuse	Charge	Elev ⁿ	Fuse	Charge	Elev ⁿ	Fuse	Charge	Elev ⁿ	Fuse
Yards	lbs	deg	ths	lbs	deg	ths	lbs	deg	ths	lbs	deg	ths
650	6	1 1/4	2	4 1/2	1 1/4	2	1 1/4	2	3	1/2	1/2	275
900	6	1 3/4	35	4 1/2	2	4	1 3/4	4	3	2	2	475
1100	6	2 1/2	5	4 1/2	3	4	2 1/4	5 1/5	3	3 1/4	3 1/4	65

9 P^r 47 6 P^r Lt 6 P^r 47 6 P^r

650	3	1 1/4	225	2	1 1/2	225	1 1/2	1 1/2	3	1	1 3/4	3
900	3	1 3/4	4	2	1 3/4	215	1 1/2	2	5	1	2 1/2	6
1100	3	2 1/2	6	2	2 3/4	65	1 1/2	2 3/4	65	..		

Light 3 P^r Canon 68 P^r Can 24 P^r Col. Mullans
8 in How

650	3 1/4	2	3	4	2 1/2	4	2		375	4	2 3/4	35
900	3 1/4	3 1/4	6	4	3 1/2	6	2		6	4	3 1/2	6

How 4 5 1/2 How Lt 5 1/2 How 24 P^r How 24 P^r

650	2	3 1/4	45	1	5 3/4	6	2 1/2	2	3	1 1/4	3 1/2	3
900	2	4 3/4	55	1	8	9	2 1/2	3	5	1 1/4	3 1/2	55
1100	2	6 1/4	65	1	10	133	2 1/2	4	7	1 1/4	3 1/2	8
1200	2	7 1/2	71	1	"	"	2 1/2	5	8	1 1/4	5 1/4	9

Mortar Practice at 45° Elevation

13 Inch Mortar

	Charge		Flight Seconds	Fuse		Range Yards
	lbs	oz		Inc	ths	
	..	14	6½	1	4½	245
	1	..	7½	1	8½	318
	1	4	8½	1	8¾	412
	1	8	9½	2	1	523
	1	12	10	2	3	613
	2	0	11½	2	4½	697
	2	4	12½	2	7½	840
	2	8	13	2	8½	906
	2	12	14	2	3	1054
	3	0	15	3	3½	1132
	3	4	16	3	6¼	1234
	3	8	16½	3	7¼	1317
	3	12	17	3	7½	1424
	4	0	17½	3	8½	1490
	4	4	17¾	3	¾	1580
	4	8	18½	4	¾	1686
	4	12	19	4	1½	1744
	5	0	19½	4	3	1824
	5	4	19¾	4	3½	1900
	7	0	24	5	2½	2510
	lbs	oz	Contents	lbs	oz	
Weight of shell	1	3¼	Powder	10	14	
Diameter of shell		12¾	Brusting Powder	6	12	
Thickness of shell		2.05 inches				

10 Inch Mortar

Charge		Flight	Gauge		Range
lb	oz	seconds	in	ths	Yards
	8	6½	1	4¾	235
	10	8	1	7½	358
	12	9	1	9¼	444
	14	10	2	2	534
1		10½	2	3	638
1	2	11½	2	3¼	749
1	4	13	2	8½	873
1	6	13½	3	9½	956
1	8	14	3	0½	1028
1	10	15	3	3	1128
1	12	15½	3	5¼	1226
1	14	16	3	6¼	1335
2	0	16½	3	7½	1357
2	2	17	3	8½	1480
2	4	17½	3	8¾	1552
2	6	17¾	3	9	1671
2	8	18	4	0¾	1780
2	10	18½	4	1¾	1780
2	12	19	4	3	1835
2	14	19½	4	4	1880
4	0	26	5	7	2536

Weight of shell --- 3 Cps 9 lb
 Diameter of shell --- 9 ¾ inches
 Powder it will contain --- 4 lb 5 oz
 Bursting powder --- 2 -- 10
 Thickness of shell --- 1.575 inches

Mortar Practice Continued					
Charge		8 Inch	Mortar		Range
lb	oz	Flight Seconds	in	ft	Yards
	5	6	1	44	225
	6	7 1/2	1	84	328
	7	8 1/2	2	04	428
	8	9 1/2	2	28	474
	9	10	2	44	560
	10	11	2	64	664
	10	11	2	80	742
	12	12 1/2	3	00	801
	13	13 1/4	3	24	859
	14	14	3	36	930
	15	14 1/2	3	42	1011
1	"	14 3/4	3	42	1115
1	1	15	3	60	1156
1	3	15	3	84	1262
1	3	15 3/4	4	06	1320
1	4	17	4	24	1380
1	5	17 1/2	4	24	1448
1	6	18	4	32	1530
1	9	19 1/2	4	60	1730
1					

Weight of shell --- 1 grs 11 1/2 lb
 Diameter of shell --- 7 1/2 inches
 Powder it will contain --- 2 lb 12 oz
 Bursting Powder --- 1 --- 14
 Thickness of shell --- 1.2 inches

Mortar Practice Continued

5 1/2 inch brass

Charge		Flight	Fuze		Range
lbs	oz	seconds	in	ths	Yards
1	8	5 1/2	1	32	155
1	12	6	1	44	198
2	"	6 1/2	1	56	255
2	4	7 1/2	1	80	316
2	8	8	1	92	380
2	12	8 1/2	1	94	426
3	"	9 1/2	2	16	470
3	4	10	2	40	540
3	8	10 1/2	2	52	590
3	12	11	2	54	630
4	"	11 1/2	2	76	725
4	4	12	2	88	746
4	8	12 3/4	3	30	800
4	12	13 1/2	3	24	910
5	"	13 1/2	3	24	935
5	4	14	3	36	1016
5	4	"	"	"	"
5	12	"	"	"	"
6	10	15	3	60	1175

Practice with Common Shells from an 8 inch Brass
Howitzer on a travelling Carriage Carried on in
1812 on Luton Heath

Ch	Time of Flight	Charges 3 rd			Recoil	Extreme roll	Remarks
		Grasses					
		1 st	2 ^d	3 ^d			
Sequence	Seconds	Yds	Yds	Yds	ft in	Yds	
POB	1	264	590	805	5' 11"	1410	
1	2	456	723	935	6' 4"	1350	
2	3	641	903	1141	6' 9"	1565	
3	3	642	948	1210	6' 0"	1230	
4	4	941	1153	1265	6' 0"	1685	
5	4	925	1283	1416	6' 8"	1583	
6	5	1121	1361	1500	5' 8"	1520	
7	6	1187	1223	1431	7' 0"	1523	
8	6	1238	1433	1483	6' 0"	1563	
9	7	1353	1500	1560	6' 4"	1685	
10	7	1350	1624	1700	6' 4"	1685	
11	8	1356	"	"	6' 0"	1670	
12	8	1680	"	"	6' 0"	1685	
13	9	1658	"	"	5' 9"	1900	
14	9	1843	"	"	6' 5"	1960	
15	9	2082	"	"	6' 4"	2000	
			"	"			

How 13. 3. 4
Can 20. 2. 15
Shells 0. 1. 14

late 4. 1. 14

The Ranges are smaller of 3
rounds. The Shorter altogether
ranged steadily although the
ranges were shorter than expected
The Charges were thought to be higher than the
Howt. were able to bear with continued firing

How 13" 3" 4"

Can 20" 2" 15"

Shells 0" 1" 14"

The Ranges are much less of 3

rounds. The Howitzer altogether

ranged steadily although the

ranges were shorter than expected

The Charges were thought to be higher than the

Howitzers were able to bear with continued firing

Abstract of the media of the first grade of the following from Bedouana with the words of the same on platforms having a slope of 1 inch to a yd Carried on at Sutton West

Garrison Carriage										Iron Garrison Carriage											
Clava	24 Pdr Length 9 1/2 feet					24 Length 6 1/2 feet					18 Pdr Length 9 1/2 feet										
	Charge 8th		Charge 6th		Cham 4th	Charge 6th		Recoil		Cham 4th	Charge 6th		Recoil		Cham 4th	Charge 6th		Recoil			
	Range	Recoil	Range	Recoil	Range	Range	Recoil	Range	Recoil	Range	Range	Recoil	Range	Recoil	Range	Range	Recoil	Range	Recoil		
Degrees	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	Yds	Feet in	
P 73	297	4	3	265	3	11	221	5	10	288	3	385	6	"	350	4	"	368	2	4	
1	720	4	0	661	3	0	381	"	5	419	3	630	5	10	630	3	7	303	2	3	
2	1000	3	0	847	2	10	777	1	11	832	3	1060	5	7	887	3	11	757	3	5	
3	1240	4	6	1213	3	4	925	2	"	1133	5	4	1340	5	8	1250	3	8	1058	3	2
4	1538	3	9	1472	3	0	1160	1	9	1308	5	4	1603	5	2	1664	3	6	1250	2	2
5	1807	3	8	1590	2	8	1371	1	7	1425	5	0	1734	5	3	1639	3	0	1365	1	8
6	2023	3	7	1742	2	7	1742	1	7	1741	4	9	1936	4	10	1801	3	8	1651	1	11
7	2100	3	3	1897	2	9	1852	1	8	2279	4	10	2192	4	5	2127	3	4	1803	2	"
8	2498	4	1	2288	2	10	2165	1	10	2250	4	8	2598	4	1	2268	3	11	1980	1	7
9	2638	3	7	2343	2	6	2025	1	6	2204	4	6	2562	4	1	2430	2	2	2100	1	7
10	2870	3	10	2673	2	11	2515	2	3	2362	4	10	2632	4	8	2740	3	5	2353	1	10
15	3510	3	8	3336	2	8	"	"	"	1300	4	3	3194	4	6	3130	3	4	3100	4	6
21	4000	"	"	"	"	"	"	"	"	3862	"	"	3610	"	"	"	"	"	"	"	"

Table of Ranges of Brass Ordnance of Different Elevations with round shot

Eleva. Degrees	Mid 12 & 9 Pounds	Lt 12 & 6 Pounds	Battering Guns			
			Elevation	Range	Elevation	Range
0° 73	300	200	0° 03	400	3 1/4	1450
1/4	400	300	1/4	500	3 1/2	1500
1/2	500	400	1/2	600	3 3/4	1550
3/4	600	500	3/4	700	4	1600
1	700	600	1	800	4 1/4	1650
1 1/4	750	650	1 1/4	900	4 1/2	1700
1 1/2	800	750	1 1/2	1000	4 3/4	1750
1 3/4	850	800	1 3/4	1100	5	1800
2	925	850	2	1200	5 1/4	1842
2 1/4	1000	900	2 1/4	1250	5 1/2	1884
2 1/2	1050	950	2 1/2	1300	5 3/4	1926
2 3/4	1100	950	2 3/4	1350	6	1968
3	1200	1000	3	1400	6 1/2	2010

Remarks

1st - The work was nearly on a level with the Battery 2nd at a range of 400 yards with a charge of Powder $\frac{1}{32}$ of the weight of shot about $\frac{2}{3}$ of the rounds took Effect at 600 yds. with charges from $\frac{1}{4}$ to $\frac{1}{10}$ from $\frac{1}{2}$ to $0\frac{1}{8}$ took Effect and 800 yds with charges with charges from $\frac{1}{4}$ to $\frac{1}{2}$ from $\frac{1}{3}$ to $\frac{1}{4}$ took Effect

3rd Rocket-batteries should therefore be placed if possible at the distance of 400 yards and not exceeding 600 yards. as from the uncertainty of firing with small charges at greater distances at least $\frac{2}{3}$ of the ammunition would be thrown away. 4th From the whole course of Practice it would appear that both with shot and shells the best Elevation to enfilade a work is from 6 to 9 degrees measure above the crest of the Parapet and the charges should be regulated accordingly 5th If 170 shells filled with powder that were fired at the work when traverses 58 took effect but only 33 of that number took burst in the work nevertheless the effect of the traverses was considered and they were much injured 6th The Times of flight are averages of the most advantageous rounds

Table of Rocket-Practice with guns & Howitzers carried on at Woolwich between the 14th of June and 2^d of October 1821

Without Shot

Nature of Ordnance	Range	Charge in lbs	Prop ⁿ the Charge bore to the shot	Elevation by quadrant Degrees	No of Rounds fired	No that took Effect	Graze made also the face	No of rounds fired prop ⁿ that took effect	No of times traverses were struck	Remarks
24 P ^r Iron	400	8	40	11	15	10	13	$\frac{2}{3}$	.	Work without Traverses
	400	10	38 $\frac{1}{2}$	7 $\frac{3}{4}$	30	9	10	$\frac{1}{2}$ nearly	.	
	400	12	32	6 $\frac{1}{2}$	30	10	26	$\frac{3}{4}$ do	.	
	600	12	32	9 $\frac{1}{2}$	30	15	19	$\frac{1}{2}$	.	
	600	1	24	6 $\frac{1}{2}$	10	17	19	$\frac{1}{2}$ nearly	.	
	600	1	4	19 $\frac{1}{2}$	30	6	17 $\frac{1}{2}$	$\frac{1}{4}$ do	.	
	800	1	24	8 $\frac{3}{4}$	30	10	11	$\frac{1}{3}$	.	
	800	1	4	19 $\frac{1}{2}$	15	30	10	$\frac{1}{3}$	.	
	800	1	8	16	5 $\frac{1}{2}$	15	11	$\frac{2}{3}$	.	
	800	2	12	3 $\frac{3}{4}$	20	15	8	$\frac{2}{3}$	.	
9 Feet	600	12	32	9 $\frac{1}{2}$	30	15	8	.	3	work Traversed
	600	1	24	6 $\frac{1}{2}$	30	20	7	.	6	
18 P ^r Iron	400	9	32	6 $\frac{1}{2}$	30	23	27	$\frac{2}{3}$	.	Work without Traverses
	600	12	24	7 $\frac{1}{4}$	30	8	11	$\frac{1}{4}$	.	
	600	1	18	5	30	10	13	$\frac{2}{3}$	.	
	800	1	18	7	30	10	10	$\frac{1}{3}$	.	
	800	1	8	12	4 $\frac{1}{2}$	30	12	$\frac{2}{3}$	.	
	800	12	24	7 $\frac{1}{4}$	30	9	18	$\frac{1}{3}$	3	
	600	1	18	5	30	13	9	.	9	
12 P ^r Iron	400	6	32	6 $\frac{1}{2}$	30	16	19	$\frac{1}{2}$	.	Work without Traverses
	400	8	24	4 $\frac{1}{2}$	30	20	21	$\frac{2}{3}$	.	
	600	8	24	7 $\frac{3}{4}$	5	11	12	$\frac{2}{3}$	.	
	600	10	19 $\frac{1}{2}$	6	30	12	15	$\frac{2}{3}$	.	
	600	12	16	4 $\frac{3}{4}$	30	2	2	$\frac{2}{3}$	.	
	800	12	16	6 $\frac{1}{2}$	30	7	10	$\frac{1}{2}$	.	
	800	1	12	4 $\frac{1}{2}$	30	15	16	$\frac{1}{2}$	.	
	800	10	24	7 $\frac{3}{4}$	15	7	3	.	.	
	600	10	9 $\frac{1}{2}$	6	15	6	2	.	.	
9 feet Service brass	600	5	28 $\frac{1}{2}$	9 $\frac{1}{2}$	10	.	2	.	.	Work without Traverses
	600	6	24	7 $\frac{1}{2}$	10	1	1	.	5	
	600	7	20 $\frac{1}{2}$	6 $\frac{1}{2}$	10	3	3	.	9	
68 P ^r Cannon	600	2	34	6 $\frac{1}{4}$	10	4	5	5	.	Work without Traverses
	600	12	32	6 $\frac{1}{2}$	25	15	15	10	.	
	600	1	24	4 $\frac{3}{4}$	10	2	2	2	.	
24 P ^r How	600	.	.	.	.	.	.	.	.	Work without Traverses
12 P ^r How	600	10	19 $\frac{1}{2}$	5 $\frac{3}{4}$	10	3	3	3	.	

Weight of Field Carriages

Nature of Carriages		No. of Pounds	Weight-			Total			Remarks			
			Cut 2" to	to		Cut 2" to	to					
Ammunition Wagon Light 6 Pounder	Body Spk Wh ^l		10	2	22	28	3	"	Weight of each charge 8 lbs			
	Lumber	130	8	"	5					4		
	Ammunition		9	"	4							
Light 6 P ^r spare wheel Carriage	Carriage		9	2	11	26	2	26		Weight of each charge 8 lbs		
	Lumber	7	3	11								
	Spare stores	9	1	4								
H 7 3 Pounder	Gun		6	"	"	25	1	18			Weight of each charge 4 1/2 lbs	
	Carriage		8	1	24							
	Lumber		8	"	6							
	Ammunition	72	2	3	16							
Ammu ⁿ Wagon H 7 3 P ^r	Body Spk Wh ^l		10	2	19	25	3	14	Weight of each charge 4 1/2 lbs			
	Lumber		8	"	6							
	Ammunition		7	"	17							
H 7 3 P ^r spare wheel Carriage	Carriage		9	"	15	24	2	26 1/2		Weight of each charge 3 lbs 14 oz		
	Lumber		7	3	11							
	Spare stores		3	3	2							
Lumber	Cart		3	3	14	5	3	22 1/2			Weight of each charge 3 lbs 14 oz	
	Ammunition	60	2	0	8 1/2							
H 7 3 P ^r	Gun		3	"	3	11	1	20 1/2				Weight of each charge 3 lbs 14 oz
	Carriage		4	"	13							
	Lumber		3	"	1							
	Ammunition		1	0	4 1/4							
Ammu ⁿ Wagon 5 1/2 in Howitzer	Body Spk Wh ^l		11	"	7	28	3	10	Weight of each charge 19 lbs			
	Lumber		8	1	3							
	Ammunition		9	2	"							
H 7 5 1/2 inch Howitzer	Howitzer		10	"	"	24	3	6		Weight of each charge 19 lbs		
	Carriage		12	3	5							
	Ammunition		3	2	26							
Light 5 1/2 inch Howitzer	Howitzer		8	1	23	26	3	21			Weight of each charge 17 lbs	
	Carriage		4	3	"							
	Lumber	22	10	1	23							
Ammu ⁿ Wagon L 5 1/2 inch Howitzer	Body Spk Wh ^l		8	1	16	28	1	9				Weight of each charge 17 lbs
	Lumber		8	"	16							
	Ammunition	62	9	1	10							

[illegible]

Nature of Carriages		No of Rounds	Weight			Total			Remarks
			Cwt	2"	in	Cwt	2"	in	
Large waggon with lockers &c	Body		9	"	8				The new Bellows Proposed will be 19" 26 to lighter
	Curbs		1	2	8				
	Lumber		7	3	11	19	"	4	
	Bellows		2	"	15				
	Smith tools		2	"	5				
	iron tools		2	"	"	4	"	5	
Gladius Waggon	ammunition		15	2	15				
Store lumber Carriage	Body & Lk w		10	"	11	15	"	2	Call for Sling Cast 3 inch rope 12 fathoms Sling 4 fathoms Sling 1/2 of 1/2 for Sling Cast 8 feet length
	Lumber		7	3	11				
Ball Cartridge Waggon new Pattern	Body		7	"	26				
	Lumber		7	2	4	34	"	18	
	20 boxes 79		1	2	22				
	20,000 rounds		17	1	18				
	1000 flints		"	1	4				
Sling cart			16	2	2	16	2	2	A common handspikes 6 ft length of
Large Gun	Gun		8	2	16				Check for a Small Gun for a traversing Platform 18 feet 6 inches Length of Check for a common Gun 16 feet
	block & tackle		2	3	25	11	2	13	
Common Gun	Gun		6	"	20	8	3	11	
Traversing	block & tackle		2	2	19	5	"	"	
Platform Carriage	Platform		5	0	"				winding 6 feet
			21	"	25	21	"	23	
Large Devil Carriage	Carriage Con		27	2	27				
	Small Do		27	2	8	35	1	7	
Tuck Carriage	Large		13	2	18				
	Small		5	1	10	19			
Large Pontoon	Carriage		15	3	21				
	Boat		10	"	"	43	"	4	
Carriage	Appentance		17	"	11				
			12	"	6				
Small Pontoon	Carriage		7	"	"				
	boat		9	3	12	28	3	18	
	Appentance		7	"	5				
Small sea boat taken with Pontoon boat	Carriage		7	"	5				
	Wood boat		3	2	"	10	2	5	

Continued				
Nature of Carriages	Weight			Remarks
	Cwt	Q ^{rs}	Lbs	
Ball Cartridge Cart	7	3	4	
Baggage Cart	8	3	22	
Hand Cart	4	1	25	
French Cart	2	2	13	
Thumbail Cart	7	0	22	

Weight of Canonade Block Trail Garrison						
Nature of Ordnance	Wood			Iron		
	Cwt	Q ^{rs}	lbs	Cwt	Q ^{rs}	lbs
60 Pounder						
42	17	1	25	"	"	"
32	"	"	"	"	"	"
24	7	1	4	11	3	9
18	7	3	21	10	3	0
12	6	1	"	8	"	"

Powers of the different Machines in the royal Military Repository

Nature of Machines	Power-supply No friction	Real power allowing for friction	Mean power a man can act with	Weight one man can raise with ease
Hand { screw	515 to 1	93 to 1	30 lb	2790 lb
{ Tack	25 1/2 - 1	21 - 1	30	630
Crab Capstan when the power is applied to the end of one of its bars —	16 - 1	12 - 1	30 —	360
Lever Roller	16 - 1	13 - 1	45 -	585
Gin Tackle	5 - 1	2 3/4 - 1	84 - 1	231
Gun { Gun with a lever	17 - 1	21 - 1	45 -	945
{ Do with a wrench	15 9/10 - 1	80 - 1	30	2400
Tower Gun	50 - 1	40 - 1	30	1200
1st Case	15 9/10 - 1	79 - 1	30 -	2870
2nd Case	328 - 1	146 - 1	30 -	4380
Jebratter Gin	91 - 1	71 - 1	30 -	2130

Power required to raise a light 6 Pounder Gun up an inclined
Plane; whose height is equal to 1/4 its length. compared with the
power necessary to move it forward on a Horiz^l plane

Weight of the gun and Carriage	—	Cwt 12.	Grs 1	Lb 4
Power required to move it forward on a horiz ^l Plane	1	—	1	0
Additional power to raise it up the inclined plane	3	—	1	6
Total Power to draw it up the inclined plane	4	—	2	6

P139 Pontoon Carriage temporary Crane

P141 Temporary Wain of a Carriage

P143 Conveying Field Artillery when Disabled

P 148 Swing bridge

Win Bridge P 149

Bag of Powder for blowing open gates

Petards have been used for a series of years for bursting open gates but are likely to be rendered obsolete by a new invention which from its simplicity and wonderful effects is almost incredible

An Experiment was tried in the commencement of 1825 (in the Royal Arsenal) Woolwich, with a bag of Powder hung on a gate: the result even ~~even~~ surpassed the expectations of the most sanguine

A Leather bag of the shape of a parallelogram containing 50 lbs of large grained ^{gun} powder it is rendered as tight as possible that the Powder from being confined might have the greatest force. A circular hole is cut in the bag about 1 inch from the bottom to which is sewed a piece of strong Leather projecting nearly 3 inches in this is inserted a brass tube which goes a short way into the bag and a portfire the length addition the tube is to prevent the leather being burnt before the powder becomes ignited. The leather is then tied closely round the tube and the end of the portfire rendering the whole compact and the air inaccessible

The Process of filling the bag is by a leather similarly attached to the top of the bag in which a funnel is thrust; through this the powder required to fill the bag is poured the leather after extracting the funnel is drawn tight with a cord

The bag is hung to the Gate by a piece of leather sewed to each upper corner of the bag on two large pins or nails

This experiment failed by some inattention in hanging the bag

A Bag of a semicircular pyramidal form like a soldiers Canteen is found to be more efficacious than the former; presenting a larger surface being hung with the flat side of the gate

The bag is filled and hotfire fixed in the same manner as before

A Pelard was used which only perforated the Gate merely effecting the local spot whereas the bag of powder burst the Gate open | which was of the same dimensions and solitude | knocking the

flown to a considerable distance and completely
breaking the rods shown across the inside of the gate

The bag which gave this result was the
latter but contained 100 lb of powder so being
considered too little

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Notes and
observations on
various subjects
connected with
artillery.

Manuscript.
[1825?]

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